THE ADOPTION OF ENERGY EFFICIENCY PRACTICES IN MANUFACTURING COMPANIES IN MALAYSIA

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by

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LIST OF ABBREVIATIONS

BPR	Business Process Reengineering
CCS	Carbon Capture and Capacity
CETP	Clean Energy Transitions Programme
CO_2	Carbon Dioxide
DOE	Department of Environment
EC	Energy Commission
EE	Energy Efficiency
EDGAR	Emission Database for Global Atmospheric Research
EnMS	Energy Management System
EPA	Environmental Protection Agency
ESA	European Space Agency
EUC	European Union Committee
EU	European Commission Union
FMM	Federation of Malaysian Manufacturers
GCCSI	Global Carbon Capture and Storage Institute
GDP	Gross Domestic Product
GHG	Greenhouse Gases
H	High
HR	Human Resources
ICT	Information and Communication Technologies
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standard Organisation

KeTTHA	Ministry of Energy, Green Technology and Water
L	Low
LCA	Life Cycle Analysis
MIEEIP	Malaysian Industrial Energy Efficiency Improvement Project
MSA	The Manufacturing/Supply Strategies Analysis
MSD	The Manufacturing/Supply System Design
MSM	Manufacturing and Supply Systems Management
NASA	The National Aeronautics and Space Administration
NEAC	National Economic Action Council
NEEAP	National Energy Efficiency Action Plan
NEP	National Energy Policy
NOAA	The National Oceanic and Atmospheric Administration
OECD	Organisation for Economic Co-Operation and Development
RE	Renewable Energy
REPN	Renewable Energy Network
UNEP	United Nation Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNESCAP	United Nations Economic and Social Commission for Asia and The Pacific
SESCO	Sarawak Electricity Supply
ST	Suruhanjaya Tenaga
PA	Paris Agreement
PDSA	Plan-Do-Study-Act
WEO	World Energy Outlook

PENERAPAN AMALAN KECEKAPAN TENAGA DALAM SYARIKAT PEMBUATAN DI MALAYSIA

ABSTRAK

Dikategorikan sebagai antara banyak perniagaan yang memberi kesan buruk terhadap alam sekitar, syarikat pembuatan sukar untuk bertindak bersama. Salah satu strategi yang paling berkesan yang dapat digunakan syarikat untuk mengurangkan pemanasan global, dan dengan itu, perubahan iklim, adalah dengan menjadi lebih cekap tenaga. Penyelidikan ini cuba menyelidiki hubungan antara pemboleh ubah bebas (inovasi, saluran komunikasi, dan ciri syarikat) dan pemboleh ubah bersandar syarikat pembuatan di Malaysia untuk mengamalkan amalan kecekapan tenaga di organisasi masing-masing, dan memetakan penerapan amalan kecekapan tenaga dalam syarikat-syarikat. Pengumpulan data dilakukan dengan menggunakan kaedah tinjauan, dengan responden datang dari seluruh Malaysia kecuali Sabah dan Sarawak kerana faktor geografi dan kewangan. Responden kajian dipilih dari Direktori Persekutuan Pengilang Malaysia (FMM). Sebanyak 660 borang soal selidik diedarkan dan 210 daripada borang soal selidik dikembalikan oleh responden, dengan kadar respons 31.82%. Data dianalisis dengan menggunakan teknik regresi berganda standard, sampai pada sejumlah penemuan penting. Hasil kajian menunjukkan bahawa terdapat hubungan yang signifikan antara inovasi, saluran komunikasi, ciri syarikat, dan penggunaan syarikat pembuatan terhadap amalan kecekapan tenaga. Dengan cara ini, penyelidikan ini menunjukkan bahawa syarikat pembuatan di Malaysia bersedia untuk melakukan perubahan terhadap amalan kecekapan tenaga dalam pekerjaan mereka untuk menjadi mesra alam.

THE ADOPTION OF ENERGY EFFICIENCY PRACTICES IN MANUFACTURING COMPANIES IN MALAYSIA

ABSTRACT

Categorised as among the many businesses having adverse effects on the environment, manufacturing companies are hard pressed to get their acts together. One of the most effective strategies that the companies can employ to reduce global warming, and thus, climate change, is by being more energy efficient. The research attempts to investigate the relationship between independent variable (innovation, communication channels and company characteristics) and the dependent variable of the manufacturing companies in Malaysia to adopt energy efficiency practices in their respective organisations, and charts the adoption of energy efficiency practices within the companies. Data collection was conducted by using a survey method, with respondents coming from all over Malaysia except Sabah and Sarawak due to geographical and financial factors. The research respondents were selected from Federation of Malaysian Manufacturers (FMM) Directory. A total of 660 questionnaires were distributed and 210 of the questionnaires were returned by the respondents, a response rate of 31.82%. The data were analysed by using standard multiple regression technique, arriving at a number of important findings. The research revealed that there is a significant relationship between innovation, communication channels, company characteristics, and manufacturing companies adoption towards energy efficiency practices. In this manner, this research suggested that the manufacturing companies in Malaysia are ready to take the change towards energy efficiency practices in their work to become environmentally friendly.

CHAPTER 1 INTRODUCTION

1.1 Introduction

According to Gillis (2015), global warming is a catastrophe for both, humans and the earth, and if not properly controlled, can lead to planet earth too. If humans ignore these facts and do not act appropriately to reduce fossil fuel use, it will create a greenhouse effect such as the melting of ice sheets, seawater level rises and loss of biodiversities (Hartmann et al., 2013). Therefore, this research will discuss the state of energy efficiency practices of manufacturing companies and, if not taken seriously, will cause Greenland and West Antarctica melting layers to be irreversible due to global water disruption of up to twelve meters due to CO2 emission (Hansen, 2007).

1.2 Research Background

Global warming could become the cause of the most severe natural disaster ever seen by humanity if the greenhouse gas emissions not brought down within a reasonable level by the end of this century (Gillis, 2015). The Fourth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC) leaves no doubt that driven by the need to generate energy from mainly fossil fuel sources, human activities have become the main reason for the rise in global warming (IPCC, 2007a). The subsequent anthropogenic global warming leads to climate change effects spanning across the whole world environmentally, socially and economically.

The problem of global warming becomes a national issue to every country in the world since climate scientists discovered a compelling relationship between global warming and climate change several decades ago (Ibrahim et al., 2013; Nik

Ahmad & Hossain, 2019; Abdul-Rashid et al., 2017). As a result of global warming, the world has witnessed climate change effects that had been manifested in various environmental issues.

Among these ecological issues, numerous researchers consider a worldwide temperature alteration as an essential problem issue confronting life on earth (Cortés-Borda et al., 2015; Jang & Hart, 2015; Yuksel, 2012; Idris & Ismail, 2011). To execute viable change, a nation needs to accomplish three objectives of sustainability, in particular, environmental, social, and economical (Nuzir & Dewanckera, 2014; Wang et al., 2014; Liu et al., 2014). In any case, to achieve this objective in Malaysia and around the world, changes from all institutions and organisations are required (Linnenluecke et al., 2012). To reduce global warming and the resultant, dreaded climate change, there must be a significant shift in the usage of fossil fuels to generate energy for human activities (Lee, 2012). According to Nurul Amin (2009) & Tonachel (2007), to reduce the dependence on fossil fuels, the world needs to have innovative thinking and gain a new edge in generating energy from renewable and cleaner sources.

The development of energy in Malaysia and worldwide is always expanding and will continuously develop (Husain & Hooi, 2015). Unusually large rising nations like India and China need to confront global warming issues because they have used the energy for their industry extensively and this has led to emissions of greenhouse gases becoming polluted (Andrews-Philip, 2014; IEA, 2017). Despite the short-term dropping of fuel costs, costs for power and the fuel will increase until the year 2035 (IEA, 2014). EUC, (2010) also stated, prices for energy are challenging in the future,

later on, environmental rules have been reported by the European Union Committee emphasised to save energy and utilise to become more productive and useful in the future. By the year 2020, energy efficiency is supposed to increase by 20%, the offer of sustainable energy needs to increment by 20%, and the greenhouse gas emissions outflows are to decrease by 20% (IEA, 2010).

In addition, a constant streamlining strategy for energy efficiency to create a comfortable and pleasant environment (Sense & React, 2015). To support manufacturing companies, the level of ISO 50001 executed measuring frameworks must have the rules on how to enhance energy efficiency practices. In Malaysia, the government has set the target to reduce the 40% carbon emission amount (NC2, 2011) and to reach a high salary country by 2020 (NEAC, 2009). According to Chandran & Munusamy (2009), the economic improvement in Malaysia is moving towards the industrial-led growth company, which is an exceedingly energy strengthened segment. To accomplish a lessening of 40% emissions the manufacturing companies can control with only considerably moves to the utilisation of low carbon innovation (renewable energy and energy proficient).

To build these potential energy-saving funds, Energy Management Systems and the distribution of ISO 50001 had actively supported these endeavours since 2011 (ISO, 2011). By differentiation, comparable ISO institutionalisation, this content focusses on the plan–do–study–act cycle (PDCA) and the abnormal state activities to be more alert by the top management. It is necessary to focus on and learn from the historical information, how to make manufacturing companies more inclined towards the form of creation of energy efficiency practices in the future

(Muller et al., 2013). The expanding of the worldwide rivalry towards manufacturing companies and manufacturing companies have entered with the new plans and abilities how to save more energy efficiency in the future for their manufacturing companies (Schuh et al., 2013). From this outcome of the pattern, the additional and unreliable machines have to keep away. Companies set up preventive upkeep, by and by to substitute parts that approaching the expired date (Balzer & Schorn, 2014; Ciupek, 2005). In this manner, the upkeep procedure is an extremely high cost (Pawellek, 2013). Using on-going machine information data can decrease the cost because by changing the parts before their lifetime (Schwab, 2014). The coordination of energy sensors is one different option to make continuous information, which reaches inferences of the machine status (Neugebauer, 2014).

1.3 Problem Statement

The objective of the energy efficiency is to reduce the use of the energy required and facilities in manufacturing companies in Malaysia such as machines and other tools become more reliable and efficient (Yusup et al., 2015). Manufacturing companies using energy have grown drastically and continue to grow significantly in Malaysia (Khorasanizadeh et al., 2015). But the global manufacturing industry is still producing the highest amount of GHG gases, and with this, all manufacturing companies need to control contamination before it gets out of control until the earth becomes dangerous to stay (Dasgupta & Roy, 2000; IEA 2007 & 2008; Fridley 2000). Energy usage such as power, gas, and oil are excessively and relentlessly expanding each year, and therefore energy efficiency practices can make the manufacturing companies plan the better operations and by that can save the cost, if not uncontrolled "energy efficiency" causing catastrophes to all sectors of the world (Lunt et al., 2014). Researchers also have found that uncontrolled energy

consumption will be the biggest contributor to greenhouse gas (GHG) emissions and will lead to increased global warming and climate change (Gibson et al., 2017).

The large-scale use of renewable energy innovations will "revolutionize global warming or dispel various ecologies and impacts of human well-being on energy use" (Jacobson & Deluchi, 2010; Aye, 2016). Global warming including in Malaysia and environmental change needs to be monitored as it can dramatically increase and can change the average temperature to become warmer and associated effects (Gillis, 2015). Several lines of logical evidence indicate that atmospheric effects are increasing (Hartmann et al., 2013; EPA, 2013; Borenstein, 2015).

Then again, Mahadevan and Asafu-Adjaye (2007), Rafiq and Salim (2009), Jamil and Ahmad (2010), Odhiambo (2010), & Belke et al., (2011) had stated the capacity of changing towards global warming is so significant and the cause of this incident should be investigated so that this situation can be regulated in the future. Smith and Ball (2012) also stated that the cost would play the leading role in how to control the energy to become more efficient at manufacturing companies. In the past studies also mentioned, the price will play the primary role of how to curb energy utilisation because it has a different decision in the previous reviews. In contrast, Chandaran et al., (2010) & Mahadevan & Asafu-Adjaye (2007) found that costs are important for the use of power and results, advanced products need to be innovated to meet more efficient use of energy for manufacturing companies (Griscom et al., 2017).

It is important to investigate the impact of energy use on yields in certain industries, particularly energy-based areas such as manufacturing companies (Hurlbut et al., 2018). Various industries have unique energy sources, and they may affect the performance of each sector in a contractual manner (Kiesecker & Naugle, 2017). To the best of our knowledge, a major study analysing the impact of energy use on manufacturing companies is to use more environmentally friendly machines and equipment to reduce greenhouse gases in the future. (Soytas & Sari, 2007; Kouakou, 2011; Bekhet & Aaron, 2012, and Turkekul & Unakitan, 2011; Funkadelic and Aaron (2012) stated that the key issue of global warming needs to be reviewed as it is not under investigation from the beginning will lead to pollution of the CO_2. From 1978 to 2009, there is demand energy continues to rise despite the high level of energy productivity and if this pattern continues the environment will be polluted in the future (International Energy Agency, 2008). From 2009 until 2016, there is the problem energy utilisation at manufacturing companies and the investigated should be carried out because some of the manufacturing companies still do not want to adopt new technology such as renewable energy at their workplace to become more efficient regarding energy practices (Renewable Energy Policy Network, 2017).

1.4 Research Objectives

The objectives of this study are the following:

- To verify the factors that contributes to the manufacturing companies for adoption of energy efficiency practices.
- To investigate the relationship between innovation, communication channels, company characteristics, and manufacturing companies adoption towards energy efficiency practices.

- To measure the condition of adoption to adopt energy efficiency practices in manufacturing companies.
- To measure the level of adoption regarding energy efficiency practices in manufacturing companies.

1.5 Limitations and Scope of Research

This study is limited to the manufacturing companies registered with the Federation of Malaysian Manufacturers (FMM). Therefore, unregistered manufacturing companies are excluded from the study. The This study is to review the latest manufacturing company systems on the technologies and equipment used in their operations towards the scope of work, and to examine machines for energy-saving; otherwise, the researcher would suggest appropriate ways to save energy on all possible equipment become the energy efficiency practice. The systems and equipment would then be utilised and to be evaluated, after that all manufacturing companies are they capable enough to adopt these new systems about energy efficiency practices in their companies. With the goal of how to extend the study can be fulfilled, all the respondents from manufacturing industry companies who are enrolled with the Federation of Malaysian Manufacturers (FMM), Malaysia will be asked about energy efficiency practices to adopt in their manufacturing companies. The information accumulation for this study was directed in eight states, to be specific, Perlis/Kedah, Pulau Pinang, Kelantan, Pahang, Selangor, Kuala Lumpur, Melaka, and Johor. Sabah and Sarawak are not spoken to in this study because of cost requirements and time restraints.

1.6 Significance of Research

This study shows how the theoretical framework is so important and how the function of the flow according to this study and practical role. Concerning its theoretical viewpoint, the review is critical because it encourages further and future research. From the past studies showed barely addressed energy efficiency practices have been implemented at manufacturing companies in Malaysia, but the present study can include significant information around there. Following this importance, this study identifies manufacturing companies in Malaysia situation and examines the impact of energy efficiency practices at their workplace. This study can reveal insight into how energy efficiency is distributed among manufacturing companies in Malaysia situation. Moreover, the study recognises the results of energy efficiency, which can add to the understanding and adopt the energy efficiency practices at their manufacturing companies.

1.7 Arrangements of the Thesis

Chapter 1: This chapter begins by providing background on energy efficiency practices in contributing to manufacturing companies. The essential part covers the research background, problem statement, research question, research objectives, and the scope of research, significant research, limitations and scope, and organisation of the thesis.

Chapter 2: This chapter examines the practice of energy efficiency. In this way, this section discusses energy innovations related to manufacturing companies. Next, the composed works relating to the green plan was shown. This writing is identifying with the worldwide and Malaysian circumstances concerning energy efficiency practices. The researcher has made it clear that company characteristics,

communication channels, innovations, and manufacturing companies adoption were monitored closely. By then, the elements that affect the status and time of choice were presented and took after by the connected structure that is utilised as a bit of this review. In the last part of the portion, the made theories were introduced.

Chapter 3: A strength clarification of the adoption theory, company characteristics, innovation, and communication channels used in this research also displayed in this chapter. Then the reception and period of apportionment of the components will be presented. At the end of the last section will be shown.

Chapter 4: Research methodology focuses on the procedures used to collect data and materials, selecting the estimates for each variable and their reliability to be prepared in steps that incorporate research design, data collection strategies, sampling design, constructive operations meanings, budgeting and procedures for data analysis.

Chapter 5: This chapter will show data analysis, research findings, reliability and validity of the concepts. The manufacturing industry company is adoption towards the energy efficiency execution and then reviewed. The summary of research discoveries was secured toward the end of this part.

Chapter 6: his chapter presents a review of the analysis measurements, discussion of significant discoveries, suggestion and the result of the analysis will be discussed, proposals for a future look into and the extensive consequence of the whole research effort that adjusted to the research objectives set.

Chapter 7: This chapter concludes this study. First, a summary of the main findings of this study is presented. Second, the limitations of the study and suggestions for future studies are provided. Finally, contributions to the theory and practical aspects of this field are highlighted.

CHAPTER 2

ENERGY EFFICIENCY AS A STRATEGY TO REDUCE GLOBAL WARMING AND MITIGATE CLIMATE CHANGE

2.1 Introduction

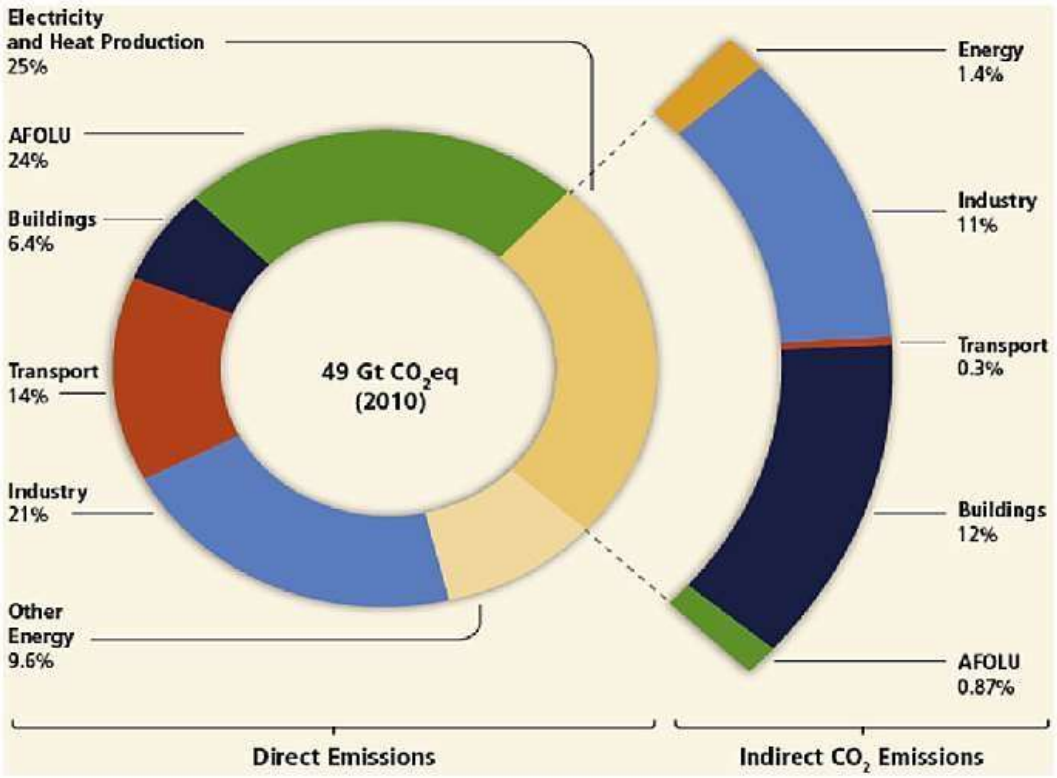
This chapter attempts to link climate change with global warming and energy efficiency. Over the years, the interplays among these three factors had forced human beings to change the ways they do things so that the natural environment could be better protected. One of the main strategies in reducing climate change is by ensuring manufacturing companies to become more energy efficient, thus emitting less carbon dioxide to the atmosphere and consequently reducing global warming. This is no easy task as it had been widely observed that tremendous industrialisation and modernisation activities in many Asian nations, with Malaysia included, had led to unprecedented energy usage increase in these countries (MIEEIP, 2008). It should be noted that, so as not to complicate discussions in the triumvirate of climate change, global warming and energy efficiency with the research topic of diffusion of innovations, there is no specific discussions on the three rating systems of Green Building Index (GBI), MyCrest, and MS1525. Further, these three systems were not referred to in the development of the research instrument used in this study.

2.2 Global Warming and Climate Change

Since the industrial revolution, air convergences of carbon dioxide (CO_2) have increased by 41% to around 400 ppm, hence surpassing levels experienced in the course of the last 65 years (IPCC, 2013). Global warming and environmental change are terms to watch because a century-scale ascended to the abnormal temperature of the Earth's atmosphere framework and related to other impacts (Gillis,

2015). Various lines of scientific confirmation demonstrate that the climate system is up to the specific level and the effect the world becomes warmer (Hartman et al., 2013; EPA, 2013; Borenstein, 2015). Despite the fact that the increase of near-surface environmental temperature is the measure of a global warming change frequently reported in the popular press, an extra portion of the extra energy has flowed into the sea, and this thing happened since 1970 (Rhein, 2013). A large number of the viewed changes since the 1950s are uncommon over tens to thousands of years ago (IPCC, 2013).

The community's reaction to global warming is alarming since the industrial revolution, the amount of pollutants in the air has escalated due to emission from the manufacturing industry and power stations, the use of fossil fuels, and the growth of transport. World nations are meeting at the United Nations Framework Convention on Climate Change (UNFCCC, 2011), whose ultimate target is to anticipate dangerous anthropogenic climate change (UNFCCC, 2011). The program sets out the measures by UNFCCC to reduce emissions in energy production, transport, agriculture and manufacturing industries as well as actions that contribute to emission reduction in working machinery, ships and residential wood combustion. Global warming increased ought to be restricted to well beneath 2.0 °C with respect to pre-modern levels, with endeavours made to control warming to 1.5 °C (UNFCCC, 2011; Sutter, 2015; Berlinger, 2015; Vaughan, 2015). Figure 2.1 shows the schematic diagram regarding the indication of the ‘Total Anthropogenic Greenhouse Gases (GHG) emissions by economic by all sectors.



Source: IPCC, 2014.

Figure 2.1. This Diagram Indicate the Total Anthropogenic Greenhouse Gases (GHG) Emissions by Economic Sector. Direct GHG Emissions Shares are represented by the Inner Circle. The indirect CO_2 Emission Shares from Final Energy use Sectors are indicated by Pull out by Section. AFOLU Symbol Indicate Agriculture, Forestry and Other Land Use Sector**.**

2.2.1 Causes of Global Warming

For the past years, global warming seems to become "uncontrolled monsters", which triggered the high alert for the community of scientists and many national governments to be more alert of this situation (Ren & Lin, 2001; Wu et al., 2016). Numerous researchers (IPCC, 2013) believe that human activities have caused all the greenhouse gases. With this current situation, climate change is hazardous to the natural environment and causes global warming to be more severe due to emissions from the manufacturing industry, power stations, the use of fossil fuels, and the growth of transport. If the atmospheric centralisation of these greenhouse gasses keeps on expanding, then the global atmosphere will be hotter and hotter (Parkes,

2013). The constant rise in temperature not only increases sea level, and this will cause all countries around the world to face an unstable climate due to global warming (Andrew, 2011; Bowden & Independent, 2017).

Mainly, all growing underdeveloped countries will confront the more difficult risk of further desertification; and the entire world will experience the ill effects of extreme natural disasters continuously (Chukwu, 2014; Clemencon, 2016). As a consequence, of worries about climate change and global treaties to reduce carbon dioxide emissions, governments worldwide are starting to build up national objectives for the arrangement of power from the renewable energy (Loring, 2007; Cheng & Zhu, 2014; NOAA, 2017b).

2.2.2 Mitigation of Climate Change

Climate change represents the best test for humanity today because the environment has changed drastically and people from around the world require the mitigation efforts required to curb the global warming issue (Vazhayil et al., 2011; Glaas et al., 2017). Solomon et al., (2009) suggest that due to climate change due to an increase in carbon dioxide concentration it cannot be restored for about 1,000 years after emission. It is incorrect to expect that simple procedures such as climate change policy can reduce CO_2 emissions quickly and can mitigate harm for several years or decades (IEA, 2014).

Mitigation comprises reducing emissions of greenhouse gasses (GHG) toward the start of the chain and each plan should adjustment reacts to monetary harms of climate change toward the end of the string (Al-Amin et al., 2010; Margado et al.,

2017). The adjustment can be proactive or responsive depending on the activity. According to Gautier & Fellous (2008) have suggested five components:

- Saving energy and growing new and productive technologies;
- Cleaner technologies for electricity generation;
- Decreasing transportation division emissions;
- Creating renewable sources of energy; and
- Prepare for the essential adjustment to future difficulties in the climate system.

2.2.2(a) Kyoto Protocol

The Kyoto Protocol is a worldwide treaty that expands the 1992 United Nations Framework Convention on Climate Change (UNFCCC, 1997). That confers State Parties to diminish greenhouse gas emissions, given the scientific consensus that global warming is happening and it is to a great danger likely that human-made CO_2 emissions to have predominantly caused it. The Kyoto Protocol was adopted in Kyoto, Japan on December 11, 1997, and came into force on February 16, 2005. There are as of now 192 nations that become the parties of this organisation (Canada pulled back successful December 2012) (UNFCCC, 2014).

The Kyoto Protocol executed the target of the UNFCCC to battle global warming by greenhouse gas concentrations in the environment to "a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC, 2014). The Protocol depends on the guideline of regular yet separated duties: it puts the commitment to reduce current emissions on developed nations on the basis that they are generally in charge of the present levels of greenhouse gases in the atmosphere (Figueres, 2012). Among the Kyoto Protocol as stated below:

- Have acknowledged targets for constraining or decreasing emissions;
- Emission decrease or responsibility for emission restriction; and
- Emission decrease or emission elimination.

These mechanisms help to stimulate a better life and meet their targets of emission reduction in a good manner by cost control.

2.2.2(b) Renewable Energy

Renewable energy is energy that is collected from renewable resources, which are naturally restored on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat (Ellabban et al., 2014; Odabashian et al., 2019). Renewable energy often provides energy in four essential areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services (Ferroukhi et al., 2013; Amri, 2017a).

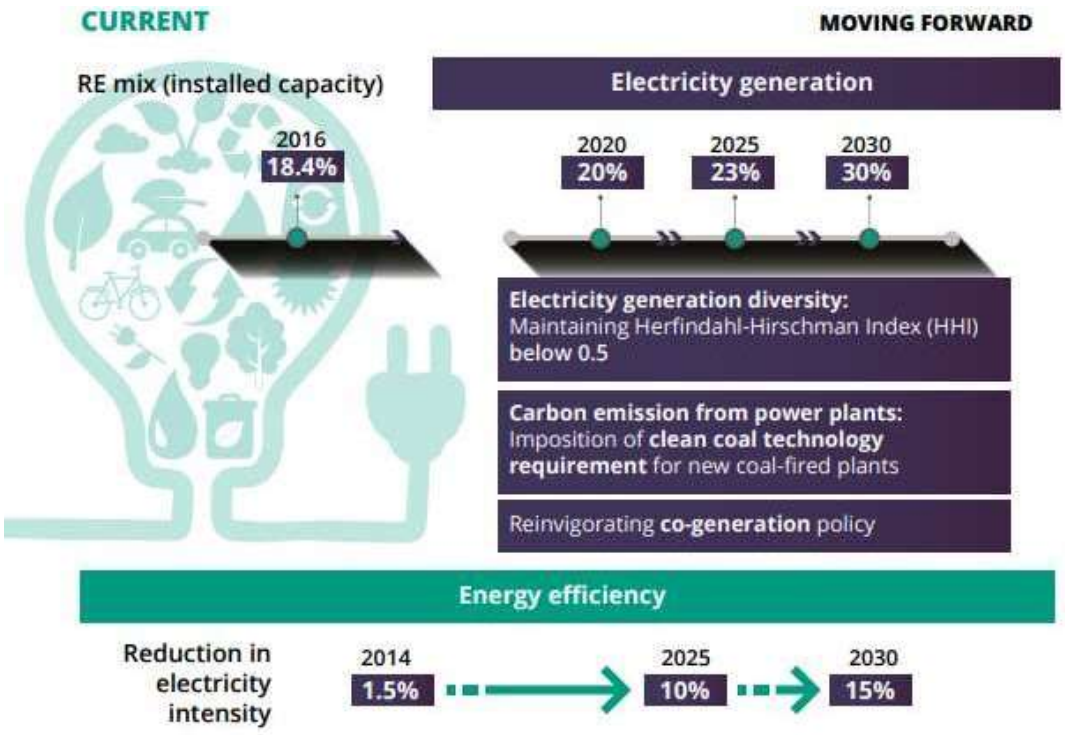
As stated by Chen (2012) sustainable power source (RE) is any primary energy from repeating and non-depleting indigenous resources, and this statement also agreed by KeTHHA. According to Malaysian National Renewable Energy Policy & Action Plan (2010), Malaysia policy regarding (RE) has been stated, "upgrading the usage of indigenous renewable energy as an asset to contribute towards national power supply security and sustainable financial improvement". The objectives are to increase RE commitment in the national power generation blend;

- To encourage the development of the RE business;
- To guarantee reasonable RE costs;
- To conserve the environment for the future era; and
- To upgrade mindfulness on the part and significance of RE.

In Malaysia, Renewable Act (2011) had implemented, and the matters are to monitor the establishment and implementation of a unique tariff system to catalyse the generation of renewable energy and to provide for related issues.

2.2.2(c) Energy Efficiency

Reducing the use of energy for manufacturing operations towards increasing some companies as it is an attractive opportunity to save more costs, time, use more energy and control climate change (Lunt et al., 2014). For manufacturing companies that use energy efficiently, it is an ethical practice; decreasing power can save the company financially in terms of expenses (Bauman, 2015). As the cost of energy keeps on rising, even a company with a generally low-energy request can see the benefit of decreasing their cost of manufacturing operations by reducing power for saving cost (Surmann et al., 2016). For an immediate recurring saving cost, it is clear utilising less energy will have decisive environmental advantages (DUKES, 2011). Figure 2.2 shows the Malaysian government's plan to gradually reduce energy to all sectors and to meet the ongoing energy efficiency requirements.



Source: Ministry of Energy Green Technology and Water Malaysia (2017).

Figure 2.2. Reduction Energy from all Sectors.

All manufacturing companies are confronting financial problem because of the expanding cost regarding energy (DUKES, 2011), in the way, these companies are not very eco-friendly and are not wary of good energy efficiency because with excellent energy can save financial problems for the entrepreneurs involved in this project and also contribute to global warming (Sundaram, 2013). In any case, most of the manufacturing companies still lack knowledge about energy-efficient practices, which they lost millions of money because of a lack of knowledge about energy and these manufacturing companies still work in an energy-wasteful way (Ru & Si, 2015). Table 2.1 shows the new initiatives of the 'Malaysia Government' to aims to promote 'Energy Efficiency' by ensuring the productive use of energy and minimising wastage.

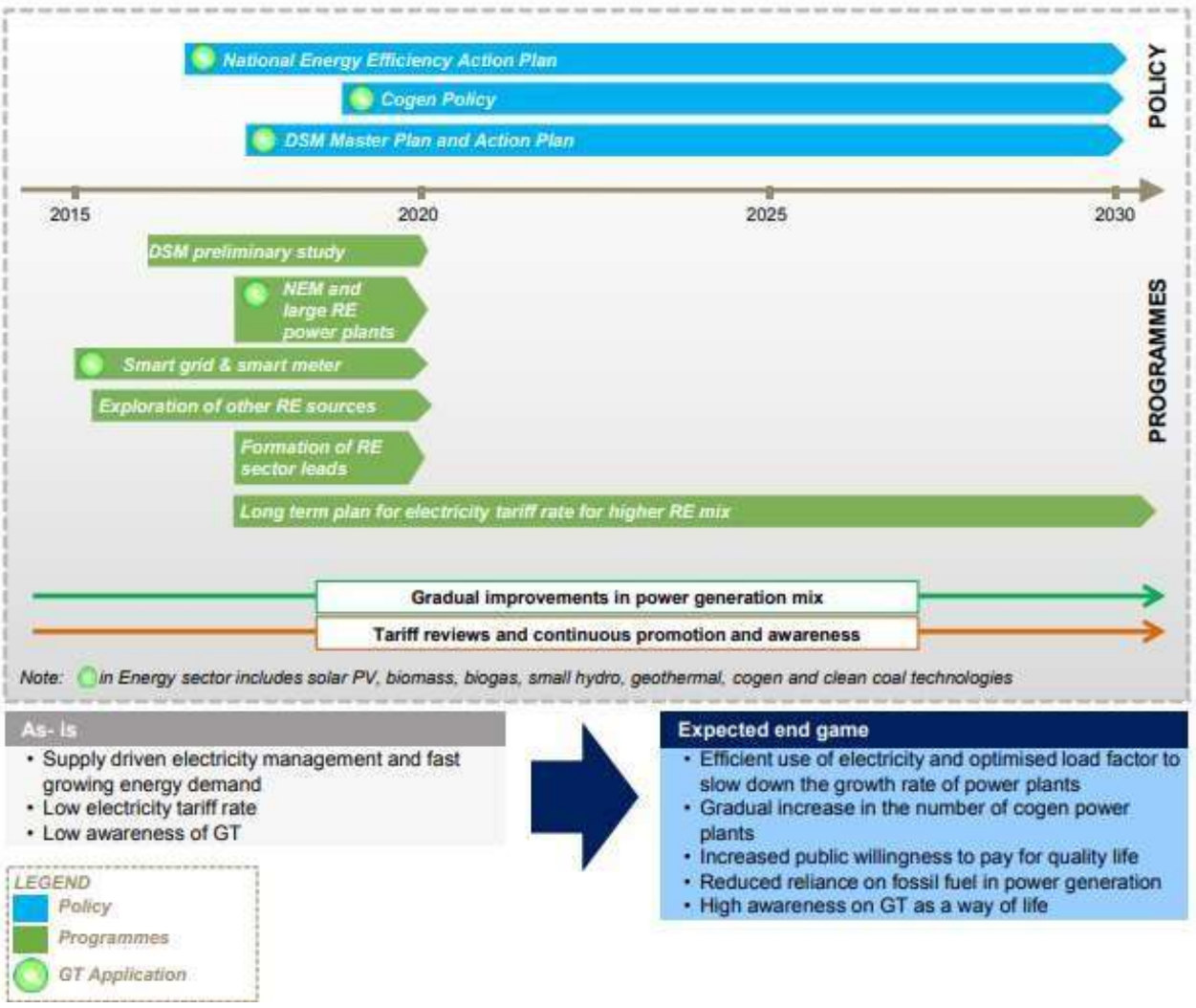
Table 2.1
Key Outcome and New Initiatives to Reach the Various Goals

SECTORS / AREAS	YEAR			INITIATIVES
	2020	2025	2030	
Electricity Generation (Renewable Energy Mix)	• 20% RE mix (installed capacity)	• 23% RE mix (installed capacity)	• 30% RE mix (installed capacity)	• Energy Planning Framework • Planting Up Scenario • Exploration of other RE sources, NEM, LSS plant, Hydro power generation plant • RE new technologies and innovation • Long-term plan for electricity tariff rate for higher renewable mix • Enhanced cross sectoral collaboration in R&D&C to develop localised technology
Energy Efficiency	-	• 10% Reduction in electricity onsumption	• 15% Reduction in electricity consumption	• Reinvigorating DSM in electricity subsector and harnessing of electricity in thermal and transport • Reinvigorating NEEAP • EE&C Act • Reinvigorating co-generation policy • Smart grid technology (incorporating digital grid etc) • Tailored communication strategy to different target audience

Source: Ministry of Energy Green Technology and Water Malaysia (2017)

According to GCCSI (2016), one of the international organisation and this organisation is set up with goals such as High Carbon Capture & Storage (CCS), an essential innovation to handle environmental change and provide energy efficiency practices. The adoption of CCS is to make it fast to control and cost-effectively because it is the right combination of success, advises and enhances innovation as it reduces greenhouse gas emissions (GCCSI, 2016). This mission by reducing energy

efficiency also agrees by KeTTHA (2016), to control and handle energy efficiency more sufficient way at manufacturing companies in Malaysia because this plan can decreasing greenhouse gas emissions. This vision is to accomplish and leading technology in the way to tackle climate change and provide good practices for energy-efficient (Ball, 2015). KeTTHA (2016) also agreed with this mission, can achieve the target such as provide quality air, energy efficiency practices, minimise the negative environmental impact arising from production/generation, conversion, and decreasing greenhouse gas emissions. With these curbs works, manufacturing companies in Malaysia can implement and practice this strategy in their company for energy efficiency strategy (Begum et al., 2015). Figure 2.3 shows the timeline for the energy sector.



Source: Ministry of Energy Green Technology and Water Malaysia (2017)

Figure 2.3. Timeline for Energy Sector.

2.2.3 Contribution of Manufacturing Industries towards Global Warming

Natural contamination is a primary concern these days. Among others, air contamination is considered as an extreme issue that may bring a problem to mother nature and for the populations in the world (Neira, 2014). Tragedies happen everywhere across the globe on various issues. The environmental effect can make mother nature not stable and can produce natural disasters such as seismic tremors, volcanic emissions, avalanches, tidal waves, rapidly spreading fires, surges, violent storms, tropical twisters, tornados (Mitchell, 2016). All those things can frequently

happen if the peoples of the world do not change their behaviour towards environmental to make it a better world in the future (Knap & Rusyn, 2016).

The significant finding is when all the weather had changed drastically for several years later and make it eminent for global warming to rising so rapidly (Denman et al., 2007). With this incident, the mother nature has transformed so aggressively towards environmental issues (IPCC, 2014). Positive criticisms must be acceptable for changed to become a better world for the next generation. If the manufacturing companies do not use, the environment (IPCC, 2013) damages energy with good practices this will lead to the destruction of greenhouse gases because power is not handled correctly until it. The mother nature will be harmful and give adverse effects to greenhouse gasses, which increasing global temperatures, rising sea levels, changing precipitation, and expansion of deserts in the subtropics (Zaelke & Cameron, 1990; Zeng & Yoon, 2012).

To control this global warming will be a little bit difficult because of the number and complex nature of modern procedures guidelines (Edenhofer et al., 2014). These guidelines need to have proper planning to become more reliable, and then the use of energy practices will be more efficient (IEA, 2008b). There is proof that energy use in manufacturing companies today is not overseen as successfully it will cause failure (Sivill, 2011). Must have good explanations from manufacturing companies to be more advance regarding energy efficiency practices in their company to become more efficient towards energy utilisation (Caffall, 1995). A few company and behavioural elements have been distinguished as boundaries to drive the manufacturing companies to adopt energy efficiency practices in their work fields

(Sardianou, 2008; Sola & Xavier, 2007; Thollander & Ottosson, 2008). However, the examinations regarding utilisation of energy effectiveness guide in manufacturing companies as a managing apparatus very limited.

2.3 Energy Efficiency Policies and Practices

Energy efficiency means using less energy to perform the same tasks - that is, eliminating wasted energy. Energy efficiency brings many benefits such as reducing greenhouse gas emissions, reducing demand for energy imports, and reducing the costs at both the manufacturing companies, household and economic levels throughout. Environmental issues, such as global warming, ozone pollution, compact wasted and air contamination, business regarding manufacturing companies is measured to be the cause of the vast majority of the environmental problems. In Malaysia, manufacturing companies are one of the economic contributors to Malaysia as a financial development (Mohd Rozar et al., 2015). Tragically, it had brought about environmental crumbling, and this is the problem for the manufacturing companies to create more emissions contrast with other industry sectors (Anderl et al., 2018). Manufacturing companies need to fulfil the demanding output from their customers, and this makes manufacturing companies will utilise their energy, not in the proper way (DOE, 2010; Ghobakhloo, 2018).

In Malaysia, the government has set an intentional focus to lower 40% carbon release amount (NC2, 2011) and also the objective of accomplishing high salary country by 2020 (NEAC, 2009). Besides, from 1970 to 1980, Malaysia's financial more focus on the agriculture industry, after several years of Malaysia economic switch to industrial segments such as manufacturing companies based on output production and this has indirectly used excessive energy (Hasan, 2007). In Malaysia,

there is an extremely constrained study on the dynamic effects of financial development, CO_2 emissions and other sectors (Rawshan et al., 2015). Table 2.2 reviews their discoveries, scientific procedures, and limits.

Table 2.2
Summary of studies on financial development, CO_2 emissions and different factors in Malaysia.

Relationships and sources	Techniques	Limitations
Positive relationship between economic growth and energy consumption, and emissions.	Johansen co-integration; VECM-based Granger causality test	Did not consider the quadratic form of GDP per capita to examine the existence of EKC.
Predicted CO_2 emissions and energy consumption should be tripled to maintain the GDP at 4.6% by 2030.	Ordinary least squares (OLS) estimation	No unit-root test although macroeconomic variables are likely to be characterised by unit root processes
Bidirectional relationship between CO_2 emissions and economic growth.	Johansen co-integration test; VECM-based Granger causality test	Presence of mixed-order integration. Johansen technique is highly sensitive to the selection of optimal number of lags
CO_2 emissions decrease with an increase of GDP per capita which indicates the existence of EKC; GDP per capita and its quadratic form as explanatory variables.	ARDL bounds testing to co-integration; VECM-based Granger causality test	Ignore other variables such as energy consumption and population. Inclusion of the quadratic form of the GDP per capita fulfils the necessary conditions for the existence of an inverted U-shaped relationship but not sufficient conditions

Self Construct

Gan & Li (2008) evaluated the normal GDP development of Malaysia will be at the midpoint of 4.6% from the year 2004 until 2030, and the real GDP would achieve US$341.6 billion by 2030 contrasted with US$107 billion in 2004. An essential change may happen in Malaysia for instance, the yield of the farming part may drop by 3%, though the industrial and administration divisions may increase over the time of 2004 until 2030. Expected that the per capita actual GDP would