ENVIRONMENTAL DEVELOPMENTS IN MALAYSIA: A REVIEW ON CHALLENGES AND OPPORTUNITIES AHEAD TO ECO-INNOVATE

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ABSTRACT

Climate change is taking a toll on governments around the world as it is a challenge to determine the most effective environmental policies to promote eco-innovation. This paper investigates the environmental developments that have taken place in Malaysia to address the challenges and opportunities to promote eco-innovation. Past and present literature was qualitatively analyzed to prepare the environmental review for this study. The results suggest that Malaysia is implementing more superior environmental policies to promote eco-innovation. Command and control-based approach is slowly being replaced with guided self-regulation approach and cradle-to-cradle principle. The evidence suggests several shortcomings where the large industries are not given adequate focus under the environmental agenda and a holistic eco-innovation framework is yet to emerge.

Keywords: *Climate Change; Environmental policy; Eco-innovation; Malaysia*

INTRODUCTION

In the 21st century, climate change is a great challenge faced by governments around the world (Gerstlberger, Praest Knudsen, & Stampe, 2014) and they have to smartly tackle this problem with various policies and incentives (Fernando & Wah, 2017). Malaysia is not spared from this global phenomenon as according to the past and present climate data, the average surface temperature in Malaysia is on the rise (IPCC, 2007; NAHRIM, 2006). Considering the intensity of emissions, environmental policies and initiatives have always favored the energy sector. In contrast, the manufacturing industry that is responsible for substantial emissions of the energy and industrial process sector (NRE, 2015) is not emphasized. Major regulations under the Environmental Quality Act 1974 assisted the enforcement of pollution prevention, abatement and control in the manufacturing industries. The regulation is command and control in nature, which provides limited flexibility for firms to develop Eco-Innovation (EI). Furthermore, initiatives and actions to cultivate EI are focused on SMEs. In fact, large organizations have greater potential to effectively develop green technology and drive the government's agenda to promote green economic growth. This is because these organizations have established technology capabilities and framework (De Marchi, 2012; Przychodzen & Przychodzen, 2015; Zhu, Dou, & Sarkis, 2010). Manufacturing sector is the second largest sector that contributes to the Malaysian GDP. By exploring the technology framework of large manufacturing industries and infusing the framework with the EI policies this can effectively contribute to EI, reduce emission and foster green economic growth.

Malaysia needs to look into effective long-term environmental policies to solve environmental problems (Rasiah et al., 2017). Understanding the shortcomings related to the environmental policies, in the future, command and control enforcement approach (i.e. the Environmental Quality Act, 1974) will be changed to a more guided self-regulation approach, which also includes the promotion on green industry and the cradle-to-cradle principle (Ismail & Julaidi, 2015). The Green Technology Master Plan (GTMP) will advocate a sector specific integrated eco-system for EI, which encompasses firm EI determinants and life cycle thinking approach. EI is touted to have a positive impact on environmental performance (Fernando & Wah, 2017).

This paper explores the environmental development in Malaysia by specifically looking into the energy and industrial processes sector. The study has three objectives. The first is to trace the environmental development that has taken place in Malaysia. The second is to explain the types of policies and incentives that are implemented by the government to solve environmental issues in Malaysia. Lastly the study highlights the challenges and opportunities in Malaysia in the arena of climate change.

This study is the first of its kind to provide a holistic view on the environmental development that is taking place in Malaysia. The findings of this study will be significant to policy makers to address the gaps that will proliferate eco-innovation initiatives among industries. Additionally, this study fills the knowledge gap in the academia that is lacking especially in terms of challenges and opportunities to promote EI. A qualitative approach was used for this study. Both printed and online resources were thoroughly analyzed to structure this review paper. The remainder of the paper is organized as follows: Section 2 explains the methodological aspects, Section 3 presents environmental developments in Malaysia looking into climate conditions and emissions in the energy and industrial processes sector, while section 4 discusses the environmental policies. The last section discusses and concludes the challenges and opportunities to promote EI.

RESEARCH METHODOLOGY

Three complementary strategies (Del Río, Peñasco, & Romero-Jordán, 2015) were executed to retrieve information related to climate conditions and policy actions taken by the government in Malaysia by specifically paying close attention to the energy and the industrial processes sector (see Figure 1). First, a *Scopus search* was carried out to identify the latest articles published using climate and policy data from Malaysia. Second, an *issue-by-issue search* was executed by specifically analysing policies and climate related documents (i.e., both published and unpublished) to find environmental shortcomings in Malaysia. Finally, a *reference list* of all the articles identified in the earlier two strategies was examined to explore emerging issues.

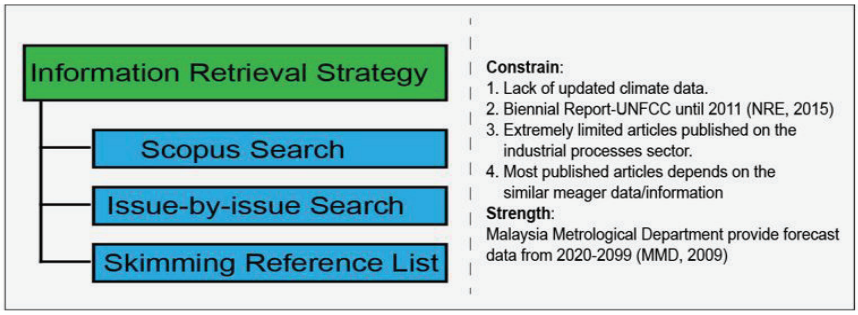

Figure 1: Research Strategy, Limitation and Strength

The major constraint for this study is the limited availability of climate data. The most comprehensive environmental report available is the *Biennial Report to the United Nations Framework Convention on Climate Change* which captures environmental data till 2011. Additionally, only a meager number of articles that assess climate conditions and environmental policy actions in Malaysia. However, the data provided by the Malaysian Metrological Department published in 2009 add value to the research as it forecasts climate data for the period between 2020 and 2099.

ENVIRONMENTAL DEVELOPMENTS IN MALAYSIA

Climate Conditions

It has been forecasted that climate conditions in Malaysia are projected to progressively escalate for years to come, as the average surface temperature is on the rise (IPCC, 2007; NAHRIM, 2006). To analyze the temperature trend in Malaysia, the Malaysian Meteorological Department (MMD) conducted a temperature analysis by plotting temperature trends for the past forty years. This analysis captured 80% of the variation in climate change for four different regions. For the purpose of the study, four different meteorological stations were used to represent each region. The Petaling Jaya, Kuantan, Kota Kinabalu and Kuching meteorological stations represented each of the West Peninsular, East Peninsular, Sabah and Sarawak region respectively (MMD, 2009). The annual mean temperature

trend for the four meteorological stations indicated an increasing trend (see Figure 2). The temperature trend showed that East Malaysia recorded lower temperature compared to Peninsular Malaysia. For East Malaysia, the average increase in temperature is 0.5°C to 1.0°C, while for Peninsular Malaysia; the increase is 0.5°C to 1.5°C. Among all the four regions in Malaysia, a significant rise in temperature was recorded in the Western Peninsular Malaysia (MMD, 2009).

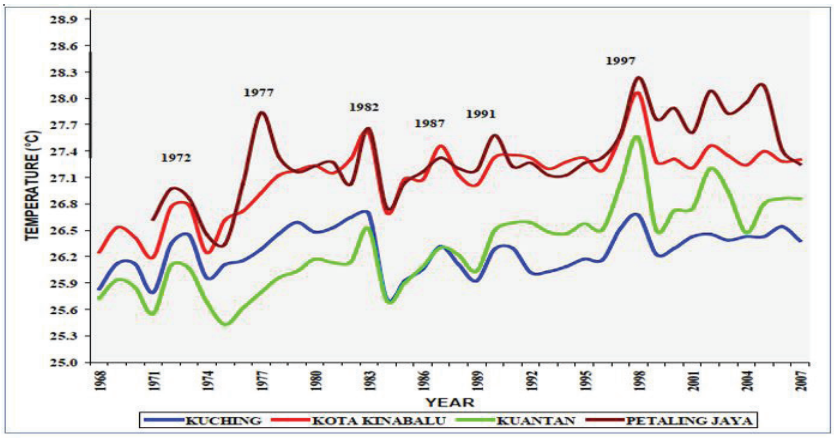

Figure 2: Annual mean temperature trend for four meteorological stations. (Source: Adopted from MMD, 2009)

To forecast the temperature in the future, an advanced regional analysis was carried out by the MMD. For the analysis, the climate-modeling tool used by MMD (i.e., Providing Regional Climates for Impacts Studies (PRECIS) model) was developed by the Hadley Center, United Kingdom. The temperature analysis was conducted for three decades namely: first quarter (2020-2029), second quarter (2050-2059), and end of the century (2090-2099) (see Table 1). The outcome of the study predicted that by the middle and towards the century's end, Malaysia would experience gradual warming. The simulations indicated higher temperatures in East Malaysia as compared to Peninsular Malaysia and Sabah, with Eastern Sarawak displaying the highest temperature during the last decade, while Peninsular with the lowest (2.9ºC). The temperature rates doubled from the first quarter to the end of the century. The highest increase is for the Eastern Sarawak

region by 2.4ºC and the lowest is for Central Peninsular with an increase of 1.7ºC.

Table 1: Annual mean temperature changes (°C) relative to 1990-1999 period

Region	2020-2029	2050-2059	2090-2099
North-West PM	1.3	1.9	3.1
North-East PM	1.1	1.7	2.9
Central PM	1.5	2.0	3.2
Southern PM	1.4	1.9	3.2
East Sabah	1.0	1.7	2.8
West Sabah	1.2	1.9	3.0
East Sarawak	1.4	2.0	3.8
West Sarawak	1.2	2.0	3.4

Note: PRECIS temperature simulations (HadCM3 AOGCM)
(Source: Adopted from MMD, 2009)

Besides the increase in temperature, unprecedented rainfalls are expected throughout Malaysia. While it is expected that the Malaysian North East Coastal region may have significant rainfall increase each month, the West Coast, on the other hand would have less. A comparative study of Peninsular Malaysia's East Coast watershed areas between past-recorded levels of river flows and their simulated future flows projected an excessive hydrological upsurge. Even the annual rainfall of Sabah and Sarawak western regions is expected to experience a considerable difference towards the end of the century (NAHRIM, 2006; Chin Tiong, Pereira, & Pin, 2009; W. Azli, Kumar, & Kumarenthiran, 2008).

Factors Responsible for Rising Temperature

Natural and anthropogenic forcing is identified as factors responsible for global warming. Climatic change over the course of time occurred due to, among others, the effect of the natural tilting of the earth's axis and the different changing patterns of relationship between the oceans and the atmosphere spanned several millenniums. Observation based on advanced climate change simulation analysis reported that natural forcing alone could not be attributed for global warming. However, natural forcing in tandem with human induced activities or anthropogenic thrusts, which causes the

release of more greenhouses gases (GHG) to the atmosphere have been observed as the contributing factors (IPCC, 2007; MMD, 2009). The main GHG emissions induced by human activities are from the increase in $CO_{2,}$ CH_4, and N_2O. This in return has caused extreme weather events due to rise in the sea water level and fluctuating ambient temperature.

Anthropogenic forcing factors have moved Malaysia from being a Nett Sink nation in 2000 to a Nett Emitter in 2005, 2007 and 2011. The trend is increasing due to a rapid increasing of industrialization with over dependence on non-renewable energy resource. Malaysia creates a sum of 9.1 PgC/y of which 45% is discharged to the atmosphere, the balance is sequestered by the forest (29%), and into the sea (26%) (EPU, 2011a). From 2005 to 2011, GHG emissions increased by 30.94%, standing at 711.760 mil tonne (see Table 2). In terms of per capita emissions and carbon intensity emissions, 9.89 tonne CO2eq/capita and 0.41 tonne CO2eq/ GDP was recorded respectively in 2011 (see Table 2). From 2005 to 2011, improvement in both per capita emissions (-1.8%) and carbon intensity emissions (-16.43%) was recorded, but at global platform, these figures are alarming.

Table 2: Greenhouse gas emission indices for Malaysia

	Unit	2002	2005	2011	% Increase (2005-2011)
Population	Million	23.3	26.1	29.1	11.49%
GDP at constant 2005 prices	Billion RM	431.234	543.578	711.760	30.94%
CO_2eq emissions	Mil tonne	197.703	262.996	287.740	9.41%
CO_2eq emissions per capita	tonne/capita	8.399	10.076	9.888	-1.87%
CO_2eq emissions per GDP	tonne/ thousand RM	0.4538	0.4838	0.4043	-16.43

Note: Calculation based on approach 1, without LULUCF
(Source: Adopted from NRE, 2015)

Emissions in the Energy Sector

For Malaysia, the energy sector is the highest emitter of GHG. Between 2000 and 2011, the emissions in the energy sector increased by 48% (see Figure 3a). Besides the energy sector, during the same duration, emissions in the industrial process sector, agriculture sector, water sector, LULUCF, and net removal increased by 46%, 35%, 45% and 14% respectively. Among the GHG, CO2 was the major source of emissions in 2000, 2005 and 2011 accounting for 73%, 76% and 72% respectively (NRE, 2015).

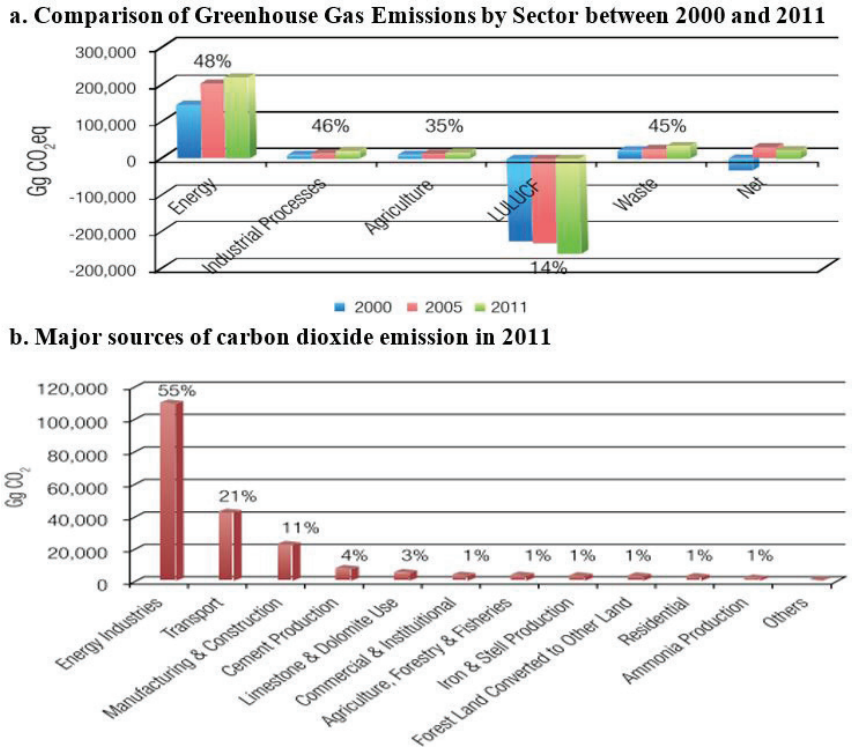

Figure 3: Greenhouse gas emissions by sector between 2000 and 2011

Note: Percentage indicates the % emission increase/decrease between 2000 and 2011. LULUCF=Land use, land use change and forest-induced by human activities

(Source: Adopted from NRE, 2015)

Among the major sources of CO2 emitters, the energy industry contributed to the highest share of CO2 in 2011 at 55% (see Figure 3b). This was because fuels utilized by auto and power producers were mainly for natural gas transformation, petroleum refining and electricity (NRE, 2015). Among the other top emitters were transport sector with a share of 21%, followed by manufacturing industries and construction, at 11%.

According to the final energy consumption data, the largest energy consumer is the transport and industry sector (see Table 3). From the total energy consumption of 46,709 ktoe in 2012, the transport and industry sector consume 17,180 ktoe (36.8%) and 13,919 ktoe (29.8%) respectively. According to the annual average energy consumption from 1991-2012, the energy consumption from the transport sector (12356.5 ktoe) is higher than the industry sector (11,664 ktoe). However, based on the statistics the high demand for energy keeps switching between the sectors during certain intervals.

Table 3: Final Energy Consumption by Sectors in ktoe

Year	Industry	Transport	Residential & Commercial	Non-Energy Use		TOTAL
1991	5835	5806	1721	1071	130	14563
1992	6455	6226	1891	1222	391	16185
1993	7012	6558	2069	2027	62	17728
1994	7486	7262	2300	1817	422	19287
1995	8341	7827	2556	2994	446	22164
1996	9834	8951	3162	1744	486	24181
1997	10106	10201	3072	2298	490	26167
1998	10121	9793	3314	2023	307	25558
1999	10277	11393	3653	1799	106	27228
2000	11406	12071	3868	2250	104	29699
2001	11852	13138	4049	2378	98	31515
2002	12854	13442	4387	2511	96	33290
2003	13472	14271	4400	2345	98	34586
2004	14913	15385	4754	2183	87	37322
2005	15492	15384	5134	2173	101	38284

2006	15248	14825	5429	2809	253	38564
2007	16454	15717	6196	2958	281	41606
2008	16205	16395	6205	2876	287	41968
2009	14312	16119	6336	3868	211	40846
2010	12928	16828	6951	3696	1074	41477
2011	12100	17070	6993	6377	916	43456
2012	13919	19757	7065	7497	1053	49291
2013	13496	22357	7403	7277	1051	51584
2014	13162	24327	7458	6217	1045	52209
2015	13989	23435	7559	5928	895	51806

(Source: Malaysia energy statistics handbook EC, 2017)

Next, based on the emission time series data the three major emitters of the energy sector are the energy industries, transport sector and manufacturing industries and construction (see Figure 4). Among them, emissions from the energy industries are the largest, with the emissions level increasing from 39.6% in 2002 to 52.0% in 2011. At the second position is the transport sector; this sector's emissions of the energy sector are 24.3% in 2000 and 20.2% in 2011. Then, followed by the manufacturing industry and the construction industry, which showed an increasing trend until 2007 and decreased gradually. In 2007, this subsector contributed to 24.3% of the total emissions of the energy sector in 2007 before plunging to 10.6% in 2011 (NRE, 2015).

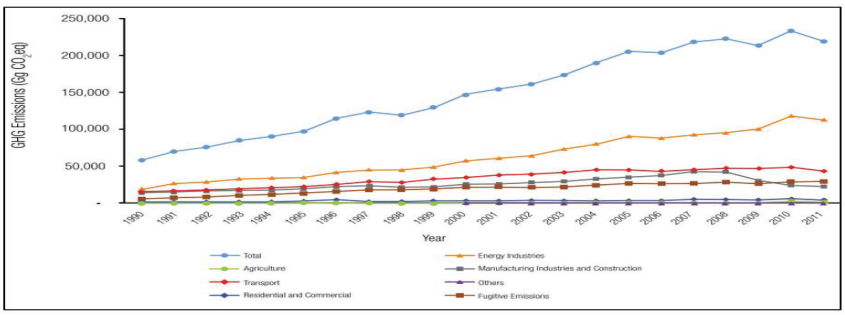

Figure 4: Emission time series from 1990 to 2011 for energy sector
(Source: Adopted from NRE, 2015)

Emissions in the Industrial Processes Sector

The second sector that requires due attention is the industrial processes sector. This sector recorded the second highest GHG emissions between 2000 and 2011 after the energy sector at 46% (see Figure 3a). Furthermore, considering Malaysia as an emerging industrial entity, greater emissions are expected from this sector in the future. Among the industrial processes sectors, the minerals products industry recorded the highest emissions, which was primarily from the cement production and with the use of limestone and dolomite (see Figure 5). In 2000, the emissions from the mineral products was 78.7% of the total emission of the industrial processes, while in 2011 was 71.9% (NRE, 2015). Metal industry and chemical industry are two other industries that relatively contributed to the total emissions of the industrial processes sector between 2000 and 2011. For the chemical industry, emissions were mainly from the production of petrochemicals and ammonia. While for the metal industry the emissions were principally from iron and steel production (NRE, 2015).

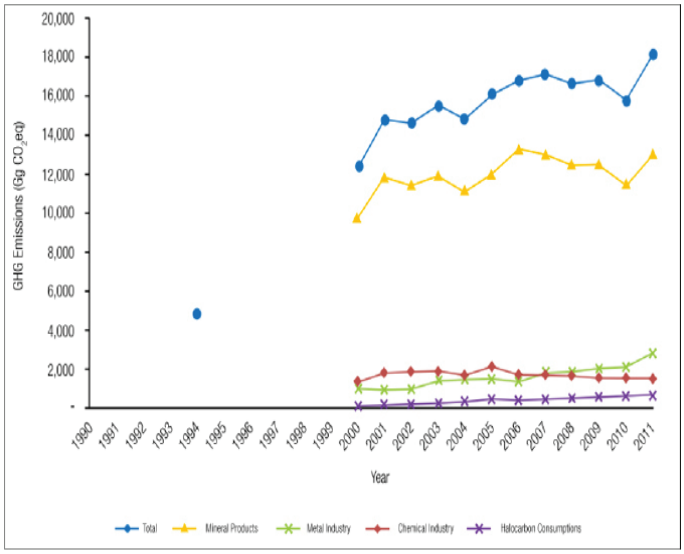

Figure 5: Emission time series from 2002 to 2011 for industrial process sector

(Source: adopted from NRE, 2015)

ACTION TAKEN BY MALAYSIA

Policies for the Energy Sector

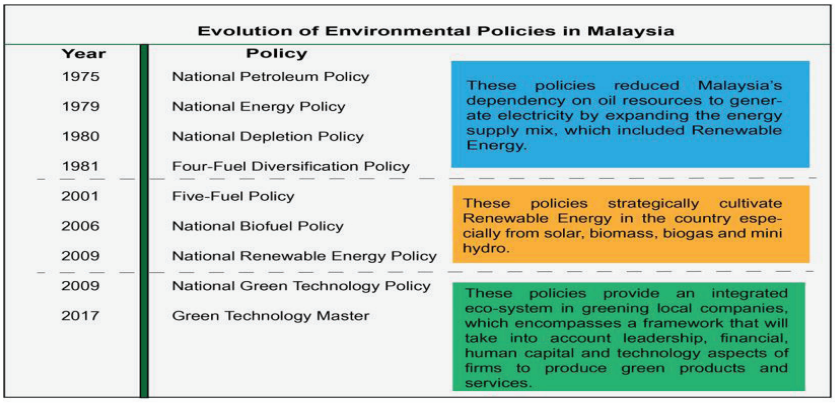

Figure 6: Evolution of environmental policies in Malaysia
(Source: Authors)

From the previous section, it is evident that the largest emissions were from the energy sector. From the very beginning, acknowledging the need for resources conservation and the need for renewable energy (RE) resources the government focused attention on the energy sector. The five major energy policies are the National Petroleum Policy (1975), National Energy Policy (1979), National Depletion Policy (1980), Four-Fuel Diversification Policy (1981) and Five-Fuel Policy (2001) (see Figure 6). These policies reduced Malaysia's dependency on oil resources to generate electricity by expanding the energy supply mix, which included RE. The inclusion of RE in the energy supply provided more RE and energy efficiency (EE) centered policies as follows: National Biofuel Policy (2006), National Renewable Energy Policy (2009) and National Green Technology Policy (2009). These policies shall strategically cultivate RE in the country especially from solar, biomass, biogas and mini hydro. The current aim for RE generation based on The Sustainable Energy Development Authority (SEDA) is 985 MW or 5.5% by 2015 and 2080 MW or 11% by 2020. To encourage the industry participation in RE development, fiscal initiative such as income tax exemption (i.e., Pioneer Status) and investment tax allowances were given. Among the successful RE projects are the Small Renewable Energy

Power Programme (SREP), Malaysian Building Integrated Photovoltaic Project (MBIPV), Feed-in Tariff mechanism, Biomass-based Power Generation and Cogeneration the Palm Oil Industry (BioGEN) and others (see Figure 7). However, RE and EE initiatives in Malaysia are still new and a lot of projects are still in progress (i.e., entry point projects (EPP) under the government's Economic Transformation Programme (ETP) (NRE, 2015).

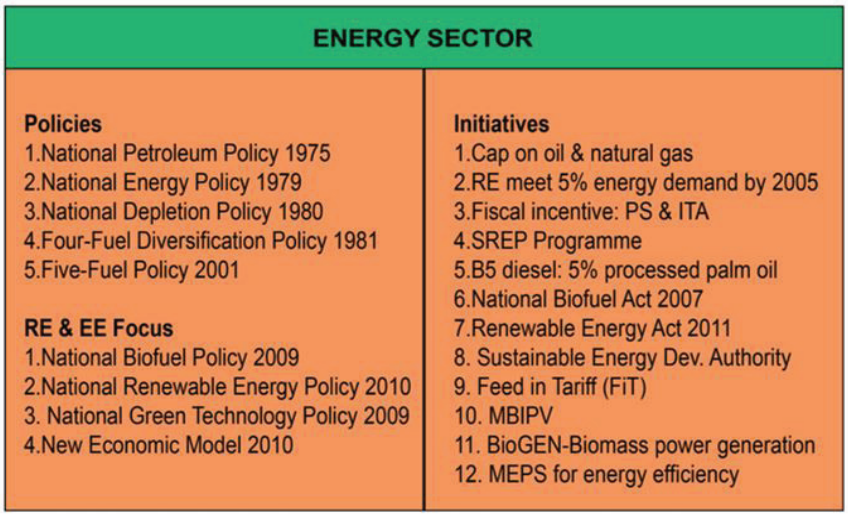

Figure 7: Policies and initiative for the energy sector

Note: PD=Pioneer status, ITA=Investment tax allowance, SREP=Small renewable energy power, MBIPV=Malaysian building integrated photovoltaic project, MEPS=Minimum energy performance standards

Source: Compiled from various reports and articles (Aldover & Hun-Yang, 2010; EPU, 2006, EPU, 2011b; GOM, UNDP, & GEF, 2011; Hezri & Nordin, 2006; Hezri & Hasan, 2004; Jaafar, Kheng, & Kamaruddin, 2003; KeTTHA, 2008; Malaysia, 1986b, 1991, 1996b, 2001, 1976, 1981; MOA, 2013; MOSTI, 2002; NRE, 2009, 2011, 2015, 2016; Oh, Pang, & Chua, 2010; Samuel, Agamuthu, & Hashim, 2013)

Malaysia is on the verge of harnessing the full potential of RE resources in the country. It is noted that moving from the initial energy conservation oriented policies to a more RE and EE oriented policies, the government's mission has changed. Where the initial mission was only to reduce emission but now this mission is coupled with the commercialization of green energy technology and green energy related products. Malaysia has partially established the upstream segment of the RE industry. And is undertaking extensive research and development to uplift the downstream manufacturing segment of RE products such as invertors, hybrid systems and energy conversion tracking systems, solar cell and others (Mekhilef et al., 2012). Therefore, in the future RE will not only

assist the reduction of emission, but also promote green growth, which is driven by green energy technologies and green energy related products.

Policies for the Industrial Processes Sector

For the industrial processes sector, the major initiative by the government is the enactment of the Environmental Quality Act (EQA) 1974 (Malaysia, 2006). The legislation under the purview of the act is pollution prevention, abatement and control. Various instruments such as licensing, discharge fees, technology standards, performance standards, monitoring, environmental impact assessment (EIA) and others were used to prevent and control emissions especially among the manufacturing industries. With increasing industrialization, EQA 1974 was reviewed and regulations that are more stringent were imposed. Besides EQA 1974, several other efforts were also made to promote green technology initiatives within the manufacturing sector. Among them is the introduction of ISO14001 (i.e., was widely adopted by large industries), Cleaner Technology Extension Services (CTES), training courses by Environmental Institute Malaysia (EiMAS) and others (see Figure 8). The initiatives taken by the government for emissions reduction is applauded. However, there is a limited scope to cultivate green technology and green products in the manufacturing sector. This is because EQA 1974 is extremely command and control in nature (i.e., enforcement and monitoring), which resulted in a lack of flexibility for firms to innovate. Additionally, major initiatives for cleaner technology are focused on SMEs and large firms are neglected (i.e., that large firms are financially strong and have the capabilities to eco-innovate). Large industries have a greater potential to catalyze EI-driven economic growth.

Furthermore, since the inception of the National Green Technology Policy (2009) (KeTTHA, 2009), efforts have been placed to promote awareness, networking and collaboration for green technology. The sectors that received greater attention under the NGTP besides the energy sector are the automotive sector, and the construction and building sector (see Figure 9). Minimal initiatives were advocated to promote the EI in the manufacturing sector. Moreover, little attention is emphasized to specific types of EI such as process eco-innovation, product eco-innovation and organizational eco-innovation. Furthermore, a sectorial technology framework is not employed to infuse initiatives and to catalyze on firms existing EI.

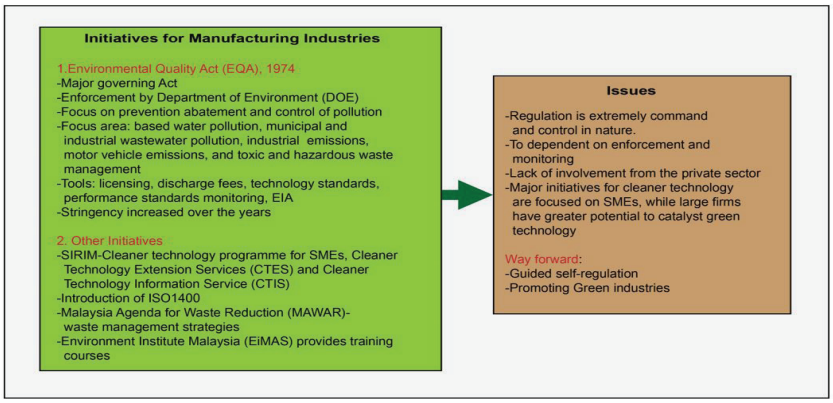

Figure 8: Environmental policy for industry

(Source: Authors' own, Ismail & Julaidi, 2015)

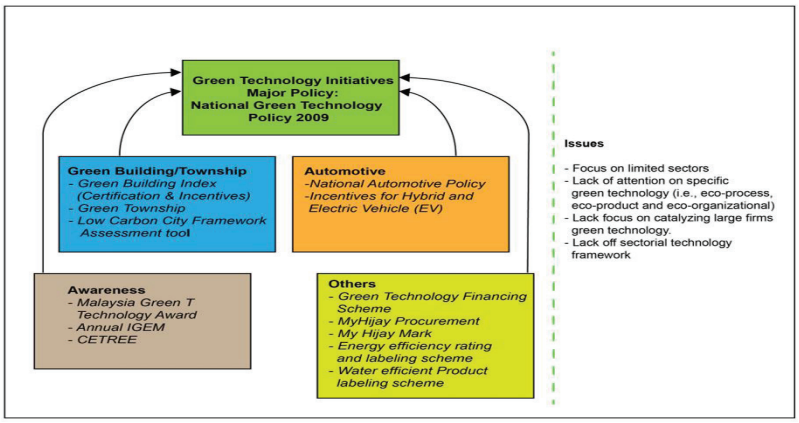

Figure 9: Green technology initiatives (i.e., non-energy related)

Note: IGEM=International GreenTech & Eco Products Exhibition & Conference Malaysia, CETREE = Centre for Education and Training in Renewable Energy and Energy Efficiency

(Source: Authors' own)

The government seems to understand the shortcomings related to the environmental policies in Malaysia. Progressively, the government is expected to address these shortcomings by changing approaches to reduce emissions, by developing a more holistic plan to promote EI in the country as well as to encourage EI-driven green economic growth. The changes that ought to take place are presented in the following section

DISCUSSION AND CONCLUSION: OPPORTUNITIES AND CHALLENGES

It is projected that in the future the command and control enforcement approach (EQA 1974) will be changed to a more guided self-regulation approach. Efforts to promote green industries and the cradle-to-cradle principle will be intensified (Ismail & Julaidi, 2015), with the launching of the Green Technology Master Plan (GTMP) (KeTTHA, 2017). The GTMP is expected to provide a more strategic plan to advocate green technology (see Figure 10). GTMP will provide an integrated eco-system in greening local companies, which encompasses a framework that will take into account leadership, financial, human capital and technology aspects of firms to produce green products and services. Besides, GTMP will also advocate life cycle thinking, which requires the firms to embrace advanced sustainable manufacturing concepts and practices. Furthermore, sector specific incentives will be provided to industries to meet the national carbon emissions target. These changes are imperative in the case of Malaysia, as Malaysia has committed to the Trans-Pacific Partnership where environment is a key negotiating area. In the future TPPA would impose greater environmental pressure towards the industries.

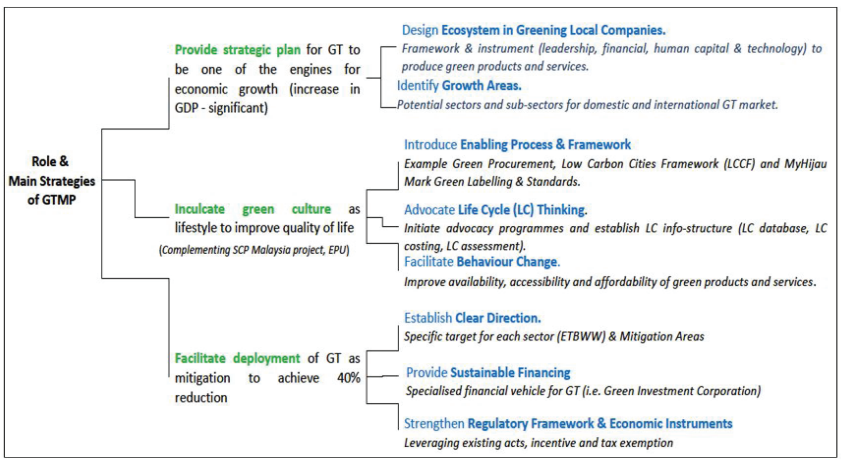

Figure 10: Green Technology Master Plan

Note: ETBWW=Energy, Transport, Building, Water Management and Water Management
(Source: Adopted form MGTC, 2014)

The GTMP is expected to uplift Malaysia's economy and strategically position the country as a Green Technology Hub (Haris, 2015). With the launch of the GTMP in 2017, multiple benefits towards the economy and well-being of the citizens are expected in years to come (KeTTHA, 2017). It is projected that by 2020, green technology contribution to the national GDP will be around 1.2% (RM 22.4 billion), and the contribution is expected to increase in 2030, at 1.5% (RM 60 billion). On the investment front, green investment is expected to increase from RM22.4 billion in 2020 to RM 28 billion in 2030. Furthermore, these investments are expected to create more green jobs, with 144, 590 jobs in 2020 and 211,500 jobs in 2030 (see Figure 11). The citizens of Malaysia can expect improved quality of life as more green cities, green jobs, better air quality, healthier society and a sustainable future is projected (Haris, 2015).

The transformation that is about to take place provides more liberty to firms to find solutions to reduce emissions, which automatically promotes EI. The GTMP is expected to provide a more sectorial approach to encourage EI and advocate more advanced sustainable manufacturing concepts and practices (i.e., life cycle thinking) to promote green economic growth. If this proposed transformation is materialized, the benefits are twofold. First, the level of emission will be greatly reduced as the enforcement has moved beyond prevention and control approach to the adoption/creation of improved EIs that has the capability to reduce more emissions. Second, the encouragement and life-cycle thinking approach towards EI will generate multiple economic benefits (i.e., green products, investment, green jobs and others) and drive green growth as propelled under the Eleventh Malaysian Plan (2016-2020) (Malaysia, 2015). However, for the proposed transformation to materialize, several issues as the following need to be addressed:

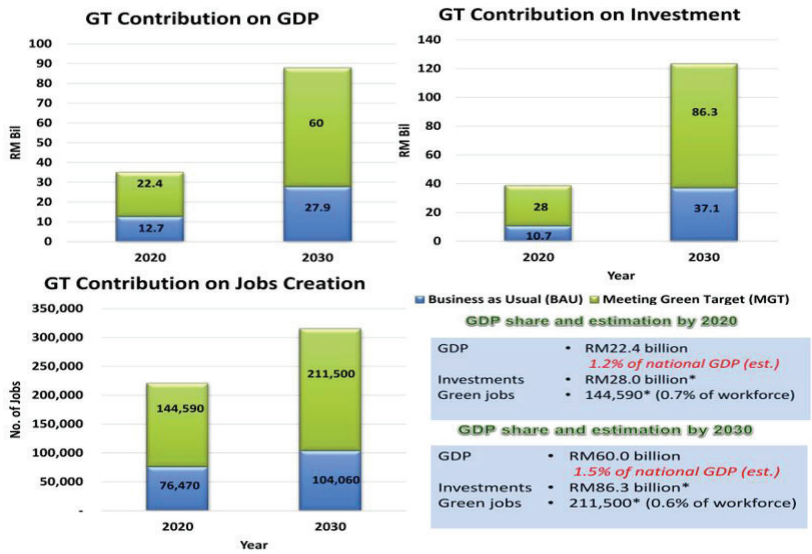

Figure 11: The prospect of Green Technology Master Plan on Malaysian Economy

(Source: Adopted from Haris, 2015)

1. Large manufacturing firms neglected

Over the years, large firms were neglected when initiatives and plan to cultivate EI were designed. Clean technological development initiatives and incentives were frequently geared towards the small and medium industries. The reason being that large entities have the financial and managerial capabilities to eco-innovate. Ignoring the financial capability, the government need to capitalize on other technological capabilities that large firm have developed. These firms have the technological framework and strategies that could be infused with EI-driven policies to proliferate the level of EI. By intervening in the already established technological framework of large firms, the government can effectively reduce the emission levels and increase EI initiatives among firms. According to the National Environmental Policy, large firms are supposed to facilitate SMEs through partnership schemes to eco-innovate (MOSTI, 2002). However, the economic managers do not emphasize on this aspect seriously. The manufacturing sector is the second largest sector that contributes to the national GDP. Therefore, large manufacturing industries requires

due attention from the policy makers. These industries will not only largely bring down the emissions level but also effectively drive green growth and sustainable development.

2. Industry driven EI framework

Researchers involved in climate change policy formulation in Malaysia highlighted several issues, which were either based on their own experience or according to opinions by others (i.e., viewpoints from various stakeholders regarding the formulation and implementation of the National Policy on Climate Change). From all the issues, three main issues were imperative to be reviewed in this study. The first issue is that there is lack of participation from the stakeholders and major groups that are directly or indirectly linked to climate change thus eroding the ability to implement responses to climate change (Chin Tiong et al. 2009). This is because there is no suitable framework or channel to enable stakeholders and policy-makers to form a strategic network and communicate, which is a necessary platform in creating national policies that would be relevant (Al-Amin, Jaafar, Azam, Kari, & Agil, 2013). The second issue is concerning policy harmonization where climate change policy goals are not synchronized with other existing policies (Pereira & Subramaniam, 2007). This automatically reduces the effectiveness of the climate change policy as the success of this policy depends on the other policies (i.e., non-environmental) as well. The final issue is that sector specific actions are required for better climate change policy results (Chin Tiong et al., 2009).

Firms have their own framework that strategically merge their technology capabilities in order to innovate. The understanding of this framework is required to determine the most imperative EI determinants, which are currently unknown. Under the GTMP, an integrated framework is proposed in greening local companies, which takes into account the EI determinants (i.e., leadership, financial, human capital and technology drivers). However, for effective GTMP outcomes, the framework has to be industry specific because it differs from one industry to another (Fikru, 2014). Through the framework, policy makers are able to identify stakeholder's role in cultivating EI. The framework also allows for a proper network and communication channel to be formed between stakeholders and policy-makers to

effectively coordinate climate change actions. More importantly, the technology framework embraced by firms are in response to previous policy. Therefore, the understanding of the framework and stakeholders' responsibility allows for better harmonization between climate change policies and existing policies. In conclusion, industry specific driven EI framework is necessary to effectively increase stakeholder's participation, harmonize climate change policies with existing policies and to implement sector specific actions as advocated under the GTMP.

3. Life-cycle-thinking approach

The way forward for environmental policies in Malaysia is the provision of guided self-regulated mechanism, which provides firms a greater liberty to eco-innovate. The GTMP advocates life-cycle-thinking approach that encourages the society to embrace advanced sustainable concepts and practices to eco-innovate. For firms to effectively embrace these new approaches to reduce emissions and to eco-innovate, it is necessary to identify the current state of EI. Information pertaining the current state of EI would encompass the types of EI that the firms are creating or adopting, and the sustainable manufacturing concepts and practices adopted. From this information, policy-makers are able to determine the intensity of actions required for firms to embrace life-cycle-thinking approach. The shift towards advanced sustainable manufacturing concepts and practices is necessary to move the industries toward a green ecosystem.

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