

IMPLEMENTATION OF RENEWABLE ENERGY CONCEPT IN THE AUTOMOTIVE INDUSTRY IN MALAYSIA: AN EXPLORATORY STUDY.

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Abstract

This paper discusses on the growing concern about the consequences of climate change, and the increase in the rate of natural disasters around the world, it becomes very important for the world to witness a great shift in the use of energy. Many solutions appeared to prevent the environment from climate change. This solution varies from developing new mechanisms and technologies to generate less CO₂ from fossil fuel such as energy efficiency concept in automotive, cement and petrochemical industries. Shifting from oil to gas in some industries like electricity generation and renewable energy which is the main focus of this research. In Malaysia, renewable energy considers as a fifth source of energy. Different types of renewable energy have been used in various sectors. The aim of this research is to understand the level of renewable energy in Malaysia, the rules and regulations that have helped green technology to flourish in Malaysia, and finally how the automotive industry responses to the changes in the business environment to meet the challenge of climate change. Four research questions have developed to achieve the aim of this research. In designing this research two methods have implemented; focused literature review and multiple case studies to understand the beginning of the awareness towards climate change as well as the current situation of the renewable energy in Malaysia, literature review is a crucial factor to achieve the research aim. Multiple case studies will be followed in this research. To have in depth understanding of renewable energy in Malaysia, case study is important. The findings of this research suggest that Green technology in Malaysia still in the developing stage. The investment in green products is too high which needs to consider in relation with market size. Malaysian government is playing the major role in supporting green concept. in terms of the public awareness, more actions need to be taken to encourage more consumers to consider green products\ services and their first choice.

Keywords: Renewable energy, Green technology

1.0 Introduction

During the last three decades the world witnessed a revolutionary effort in conducting researches, developing technologies, and forming strategies and government policies to mitigate climate change; the focus was what have been done to deal with the global warming. Some people might think that this is the beginning use of green energy or energy produces less CO₂. Infact, the use of clean energy was very clear during the various stages of history (Daniel, 2012). For example, renewable energy is the oldest form of energy in the history, the first form of energy that mankind was able to control. Using sunlight for heating

and lighting, wind to travel in the sea, all are examples of renewable energy usage in a simple form. With the emerging of industry revolution, there was a need for new types of energy that can sustain in the long term with reasonable price. From that point, renewable energy had replaced by Fossil energy coal, oil, and later natural gas. This was the beginning of "gasoline era", which causes pollution and difficult relationship (politically and economically) between countries controlling the petrol reserves, and those who need energy to grow. Oil becomes the dominant energy in all aspects of life (Demirbas, 2009). There is no doubt that oil considers as one of the most influential factors that contributed to the industry revolution and later technology revolution. As it's the nature of the world everything has its advantages and disadvantages. The rising of climate change, gave signals to start searching for new source of energy that can be relatively cheap, easy to obtain, sustainable and most importantly environmental friendly. Countries, researchers, entrepreneurs, government, multinational companies as well as small companies, NGOs and Environmental groups, all have been searching for the best way to save the globe, what kind of energy can be used to help save our planet?, what are the mechanisms we should implement to reduce the effect of global warming?. These are some of the questions that environmentalists are trying to answer. Many solutions have been introduced to prevent the environment from climate change. These solutions varies from developing new mechanisms and technologies to generate less CO₂ from fossil fuel, good example to consider here is the implementation of energy efficiency concept in automotive, cement and petrochemical industries. Shifting from oil to gas in some industries like electricity generation and finally, renewable energy which is the main focus of this research. The research questions of this study are 1) Who are the players in implementing renewable energy? 2) How the Malaysian governments react towards climate change? 3) How transport sector in Malaysia is dealing with the issue of climate change? and 4) How could be described the opportunities in transport sector the private companies can take to deal with the issue of global warming?. The research objectives of this study are to understand the level of renewable energy in Malaysia, the rules and regulations that have helped green technology to flourish in Malaysia, and finally how the automotive industry responses to the changes in the business environment to meet the challenge of climate change. Next, the scope of the research is explained clearly through figure 1.0 below.

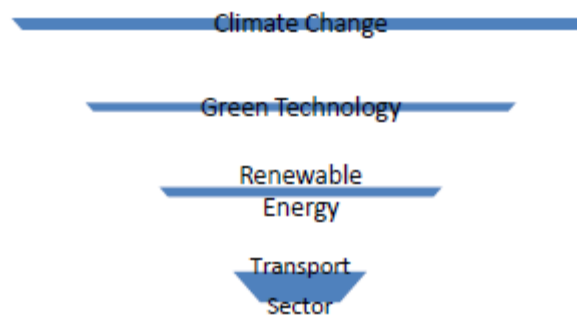


Figure 1: scope of research

The flow of this research pursued on four stages. The first stage starts with the idea of understanding what the world has done to address the issue of global warming. It's important to have a clear picture about how the international community, multinational companies, and entrepreneurs look towards global warming. To have a better understanding of this topic and to answer the research questions. It is important to study the history of climate change, and the actions that have been taken to tackle this problem by the international community. From that point, the researcher moved to the next stage which is the proposed solutions to solve climate change. Many solutions have been developed to reduce the effect of climate change. Realizing that it is important to study and understand these solutions to determine which one of it to be focused. At the end, the decision made to study green technology.

Under green technology, there are different approaches such as: energy efficiency, Carbon capture and storage, recycling and renewable energy. Stage three deals with the practice of renewable energy. The term renewable energy used to describe these types of energy which produce less or zero CO₂. Studying renewable energy will be based on the drivers behind renewable energy, which are; private sector, government and society. The choice of these factors made according to the reading and literature the researcher has done to support each one of it. The last stage which is the main focus of this researcher is transport sector. Having reviewed the renewable energy in terms of types, use and its benefit, the researcher found that the best way to study renewable energy is in transport sector in Malaysia. Not only in Malaysia but in many countries had transport sector considered as one of the major producer of CO₂.

2.0 Literature Review

Climate change closely linked with other environmental issues and the challenge of sustainable development itself. The effects of climate change as once thought unthinkable and now sought to avoid. Climate change, also called "global warming" is the most serious and most complex environmental issues ever to confront the international community. Developing countries in particular are becoming more and more concerned about how climate change will affect them, and they do not possess the wealth to protect their populations from the effects of natural disasters such as flooding. Developing countries need to invest more and more in the green energy. R&D in those countries should focus on how to develop a new source of Energy that has less negative impact on the environment with low cost comparing to the biomass energy

2.1 What is renewable energy?

The continuing depletion of fossil fuels and the environmental hazards posed by the needs of future development are gradually shifting the path of development toward sustainability, better sociability and environmental responsibility which in turn emphasize the need of renewable energy sources (Tiwari & Ghosal, 2007). The term of Renewable energy, refer to energy that comes from natural resources such as sunlight, wind, rain, and tides. About 16% of global final energy consumption comes from renewable, with 10% coming from traditional biomass, which is mainly used for heating, and 3.4% from hydroelectricity. New renewable (small hydro, modern biomass, wind, solar, and biofuels) accounted for another 3% and are growing rapidly (Renewable energy global status report, 2011).

There has been a rapid growing in renewable energy concept especially between developing countries. Worldwide renewable energy capacity grew at rates of 10-60% annually for many technologies. For wind power and many other renewable technologies, growth accelerated rapidly comparing to previous years. In 2010, renewable power totaled about a third of the newly built power generation capacities (Global Trends in Renewable Energy Investment, 2007). According to the International Energy Agency; solar power generators may produce most of the world's electricity within 50 years, dramatically reducing the emissions of greenhouse gases that harm the environment (2011).

Renewable energy may be particularly suitable for developing countries. In rural and remote areas, transmission and distribution of energy from fossil fuels is difficult and expensive. Producing renewable energy locally can offer a good alternative. Technological advances are opening up a vast new market for solar energy. Renewable energy projects in many developing countries have demonstrated that renewable energy can directly contribute to enhance the lifestyle by providing the energy needed for creating businesses and job opportunities. Renewable energy technologies can also make indirect contributions to provide energy for cooking, space heating, and lighting. Renewable energy can also contribute to education, by providing electricity to schools (Energy for Development report).

2.2 Where does renewable energy come from?

According to —renewables guidel website there are six primary types of renewable energy; Wind, Solar, Biomass, Geothermal, Hydro Power, and Biofuels (2011). The most famous from of these six types are solar energy which used for electricity generation and heating water, space, and Biofuel. A biofuel is a type of fuel whose energy is derived from biological carbon fixation. Biofuels include fuels derived from biomass conversion, as well as solid biomass, liquid fuels and various biogases (Demirbas, 2009). Solar energy is an alternative energy source that involves harnessing the radiant light energy emitted by the sun and converting it into electrical current (Azman, et al, 2011). In Malaysia for example, solar power or also known as photovoltaic (PV) system is estimated to be four times the world fossil fuel resources (Hitam, 1999). There is another type of renewable energy which is biomass. Biomass can be defined as a biological material derived from living, or recently living organisms. In the context of biomass for energy this is often used to mean plant based material, but biomass can equally apply to both animal and vegetable derived material (Biomass Energy Center).

In ecology, 'biomass' is the mass of organic matter in the 'standing crop' of an ecosystem, such as woodland or a cornfield. The term has been taken over (and distorted) by energy technologists and come to mean the mass of combustible material of organic origin in any volume of material (Azman, et al, 2011). Hydro power uses to generate electricity especially in countries like Malaysia, a country gifted with a lot of water resources. Though hydro power is one kind of RE, it is placed separately in the energy mix as hydro power is expected to play a more prominent role in the generation mix. It is expected that its share will increase from 5% in 2008 to 35% in 2030 for Peninsular Malaysia (Islam, et al, 2009). Wind energy is classified as the pollution free power sources that can be harnessing to gain an electrical power at almost all location (Farriz, et al, 2009). The terms wind energy describes the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power (Azman, et al, 2011).

In summarization, there are different types of renewable energy can be used to replace fossil fuel. Solar, wind, and biofuel, are among the most popular form of renewable energy. The dependency on renewable energies to generate electricity consider as one of the most rewarding business opportunities.

2.3 What are the advantages and disadvantages of renewable energy?

Renewable energies are the most suitable kind of energy that can save the planet for the next generation. One of the benefits in utilization of renewable energy resources is the sustainability of energy supply in the long term. Other benefit of promoting the utilization of renewable energy is the reduction of the greenhouse gases that have a negative impact on the environment from the consumption of fossil fuels (Johari, et al, 2011). Although renewable forms of energy such as solar, wind, or geothermal power are better for the environment, renewable resources are more costly than fossil-fuel-fired technologies, in part because renewable energies are capital-intensive, requiring hefty initial expenditures on equipment in exchange for lower operating cost over time, and renewable energy's environmental and risk diversification benefits are public goods and tend to be undervalued by electricity producers, utility regulators, legislators, and consumers (Mayer et al., 1997).

A small comparison between the investment and the outcome in both fossil fuel and renewable energy in a large scale and long term value shows that fossil fuel is better. It's important to mention that this picture believed to change in the near future, especially with increasing cost of fossil fuel. The

awareness and responsibilities of the society play an important role in triggering the decision to invest in renewable energy.

2.4 Overview of transport sector in Malaysia

The researcher was aware that there are three types of transportation; land transport, maritime transport, and air transport. The focus in this research will be only on land transport. As this research focusing solely on automotive industry in Malaysia, the researcher opted to study the road transport in Malaysia and not dealing with other type of transport. For every country, transport sector is vital to bring more investment to the country and push the economy forward. For developing countries, transport sector consider as one of its competitive advantages that the country should maintain. In the case of Malaysia, the government gives a special attention to improve this sector. Malaysia is consider as a hub for trading and travelling in Southeast Asia, which resulted in an increase rate of CO₂ in the atmosphere .Transport sector in Malaysia considers the second largest consumer of energy at 3.9 percent just after the industry sector at growth rate of 4.3 percent. **Figure 2.0** shows the projected demand of energy. Final energy demand is projected to grow at 3.9 percent per year, reaching 98.7 Million Tons of Oil Equivalent (MTOE) in 2030, nearly three times the 2002 level. More than 35% of the nation's oil consumption is by transportation sector (Kari, & Rasiah, 2008).

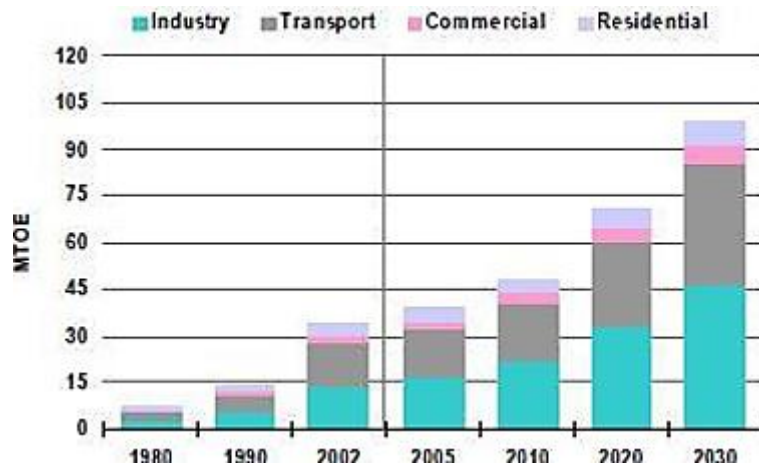


Figure 2.: Projected demands for energy in Malaysia

Source: (APEREC, 2006)

Energy consumption for transport accounts for approximately 20% of all energy used worldwide and approximately 25% in many OECD countries. In order to lower the CO₂ emissions it is an absolute necessity to introduce renewable energy in the transport sector and have the sector integrated in the energy system (Hans & Petersen, 2009). In Malaysia, Energy demand in road transport is projected to grow at an annual rate of 3.5 percent. By type of fuel, gasoline growing at 2.9 percent, and diesel at 4.2 percent per year (APEC, 2006). There is more pressure on use of energy and demanding for new source that can reduce CO₂ emissions, and in the same time cheap to use. **Figure 2.1** addresses the number of different type of vehicles on the road in Malaysia between 2007 and 2011.

NEGERI STATE	2007		2008		2009		2010		2011	
	AKTIF Active	TIDAK AKTIF Non-Active	AKTIF Active	TIDAK AKTIF Non-Active	AKTIF Active	TIDAK AKTIF Non-Active	AKTIF Active	TIDAK AKTIF Non-Active	AKTIF Active	TIDAK AKTIF Non-Active
PERLIS	52,218	13,807	58,557	15,171	56,831	16,482	83,743	18,045	86,618	19,373
KEDAH	589,434	272,977	805,125	290,892	835,969	309,567	871,989	230,155	717,393	247,955
PULAU PINANG	1,403,290	385,254	1,478,826	418,812	1,540,529	453,974	1,614,307	492,924	1,686,521	527,228
PERAK	1,150,534	407,224	1,207,765	439,055	1,255,105	470,667	1,305,940	565,529	1,381,606	537,183
SELANGOR	1,418,472	536,539	1,482,328	582,648	1,527,221	628,523	1,582,587	679,298	1,638,011	727,322
WILAYAH PERSEKUTUAN	3,089,040	646,437	3,331,039	708,747	3,240,433	774,901	3,780,000	849,040	4,041,037	922,008
NEGERI SEMBILAN	483,267	206,301	490,407	220,585	507,097	235,400	525,037	251,757	544,534	268,955
MELAKA	419,595	150,509	445,282	181,471	465,696	172,778	487,240	185,188	508,414	198,547
JOHOR	1,723,423	604,748	1,831,776	654,589	1,912,894	707,086	2,003,475	764,791	2,105,420	818,478
PAHANG	479,264	186,947	518,322	204,230	542,982	219,763	570,853	237,155	603,606	252,373
TERENGGANU	278,455	91,855	303,785	99,317	326,888	108,844	351,839	115,242	376,449	122,952
KELANTAN	373,758	156,340	409,294	166,776	440,088	177,637	473,470	190,382	505,713	203,021
SABAH	508,443	186,037	553,765	190,184	596,291	195,463	648,011	213,270	712,093	230,344
SARAWAK	815,794	223,007	885,888	248,393	912,578	274,193	968,255	301,413	1,030,390	323,748
MALAYSIA	12,758,590	4,053,042	13,578,457	4,391,840	14,271,570	4,743,518	15,053,772	5,134,793	15,906,655	5,494,514

Figure 2.1: Number of Vehicles on the Road by State, Malaysia, 2007-2011

Source: (Road Transport Department)

Malaysian economy is developing so fast that most of the people affordable to have private vehicle\ and hence the vehicle population has also boomed (Lynn, & Boyle, 2008). Road transport is the main energy consumption within the transportation sector.

2.5 Who are the actors of renewable energy in Malaysia?

Malaysia as a country consider as one of the mega-biologically diverse country in the world, with rainforests covering 60% of landmass. Since the debate has started about the issue of climate change, Malaysian government has considered global warming as a core in all it is social and economic policies. In order to achieve a Sustainable growth Malaysian government has been focusing on creating healthy ecosystem. The cooperation between federal government and state. governments has resulted in developing policies and measures to protect the environment with optimal use of natural resources. As a developing country, Malaysia has commitments to reduce emissions and increase the use of clean technology. Malaysia agreed to reduce its carbon emissions 40 per cent by 2020 with support from developed countries (Azlan, et al, 2009). The government has established various programs for this reason. Malaysia is already committed under the United Nations Framework Convention on Climate Change (UNFCCC) to formulate, implement, publish and regularly update national and, where appropriate, regional programs containing measures to mitigate climate change by addressing the emissions by sources and removals by sinks of all greenhouse gases. Oil and gas have been the main energy sources in Malaysia. However, with its gas reserves estimated to last for another 33 years and oil reserves another 19 years, the Malaysian government is strengthening the role of renewable energy (RE) as the fifth cornerstone of energy generation. Malaysia is one of the most developing countries among ASEAN countries next to Singapore, with GDP of US\$15,400 per capita (PPP basis), and steady GDP growth of 4.6% in 2009 (IMF, 2010). Many manufacturing companies in Malaysia are already trying to save energy costs.

This creates opportunities to companies offering energy management services to determine ways for saving energy and costs. The growth of fuel consumption in Malaysia is estimating to increase driven

by industrialization. In Malaysia, coal consumption for electricity generation grows at a rate of 9.7% per year since 2002. The increase in coal utilization usually tallies fairly well with the increase in CO₂ emission. (Johari, et al, 2011). In parallel with Malaysia's rapid economic development, final energy consumption grew at rate of 5.6% from 2000 to 2005 and reached 38.9 Mtoe in 2005. The final energy consumption is expected to reach 98.7 Mtoe in 2030, nearly three times the 2002 level. The industrial sector will have the highest growth rate of 4.3 percent (Islam, et al, 2009). As it is common perception that a nation's economy and use of energy will always grow hand-in hand, the Malaysian government, in its 8th Malaysian Plan (2001-2005) has declared RE as the country's fifth fuel in the energy supply mix to diversify its energy source. Currently, the energy supply mix in the country is made up of gas (70 percent), coal (22 percent), oil (2 percent) and hydro power (6 percent) (8th Malaysian Plan).

2.6 Theoretical framework

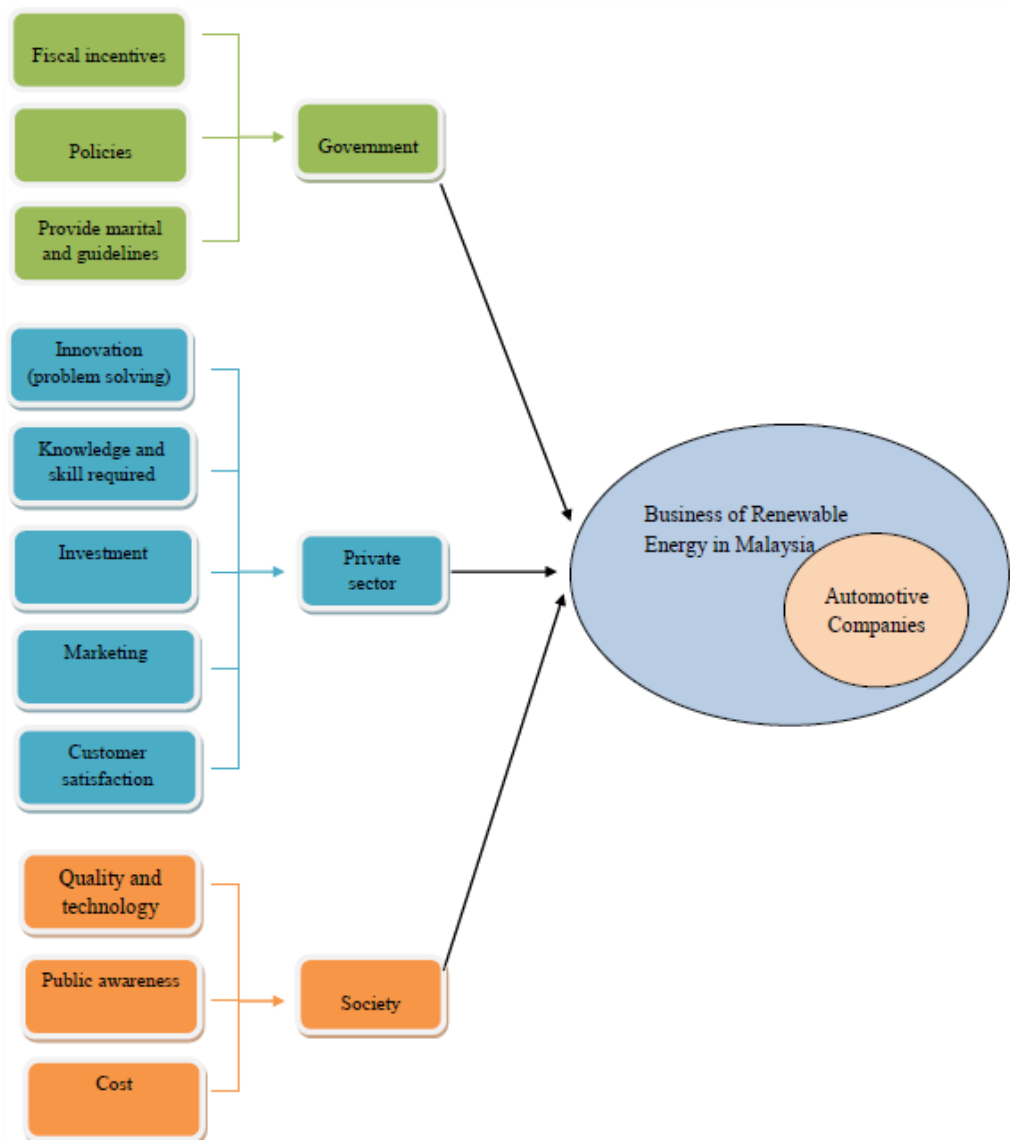


Figure 2.2: Theoretical Framework of Factor involving in Automotive Industry

3.0 Research Methodology

The aim of this chapter is to present methods, tools, and strategies to be used in this study. Following paragraphs will discuss four sections; philosophical framework, research strategies, research design, and method of research. In choosing a proper methodological approach, this research will adopt beech, (2005) research design map as shown in **Figure 3.0**.

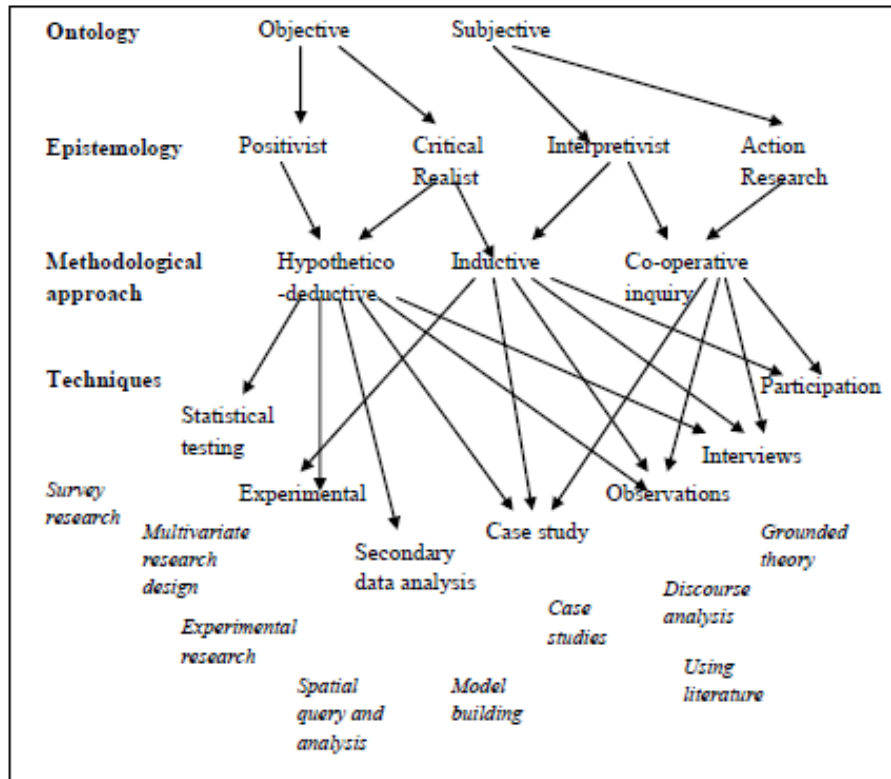


Figure 3: Research Design Framework

Source: Adopted From (Beech, 2005)

The reason of choosing Beech's model goes to the fact that in order to conduct this research the researcher has reviewed a few research design maps to choose the most suited for this research. The researcher was aware that there are many approaches and methods to conduct this research. The researcher has found that Beech's model is very comprehensive. It contains all the elements of the methodological approach that the researcher wants to pursue. It's simple, flexible, and well designed to prevent the researchers from losing direction throughout the research process. This chapter ends by presenting the quality criteria that the researcher thinks that is the most appropriate approach to examine the quality of this research.

Below is the research process.

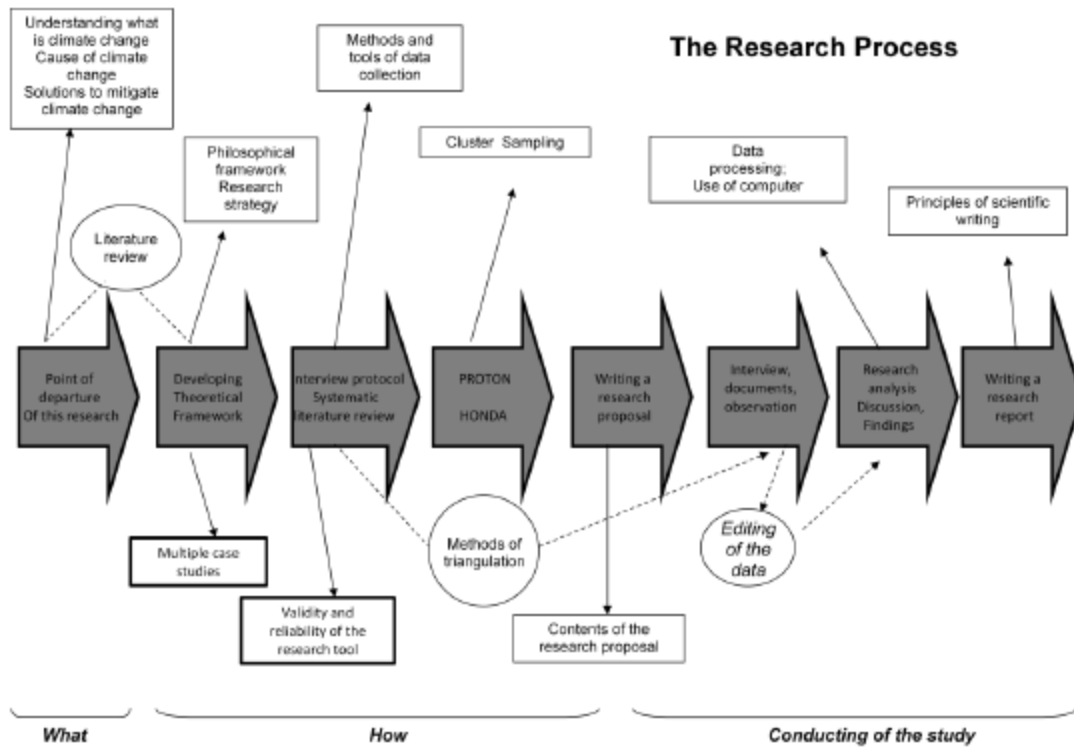


Figure 3.1: Research Process

Source: (Kumar, 2011)

4.0 Discussions And Data Analysis

4.1 Case Study1

Proton is the first Malaysian local car manufacturing. It's important for this research understand the work carried by the company to introduce its first green car to the local market. The focus will be on the electric car that the company is developing currently. The case study will discuss the company and its work and the level it has reached in developing its green car.

i) Case Study 1 Comparison with Theoretical Framework

The following discussion compares the empirical data with the theoretical framework. Three phases to be highlighted in this section; public sector and the initiatives of the government to improve the business environment for green technology in Malaysia, private sector and its role in developing renewable energy in Malaysia, lastly, society and the potential of green consumer in automotive industry in Malaysia.

Table 4: Public Sector Patterns of Analysis

No.	Phases	Description
1	Fund and fiscal incentives	Malaysian government has provided Proton with fund regularly. Several indicators have showed that the government funded Proton every year for the reason of R&D. The government allocated RM100 million this year for Proton to develop a hybrid and electric model and will consider an allocation of RM120 million next year for research and development.
2	Rules and regulations	import duties and taxes levied against foreign carmakers, Proton was also the recipient of tax breaks and "other government incentives."
3	Promoting the concept of renewable energy to encourage society make use of it.	The government has agreed to reduce its GHG 40% by 2020 compared to 2005 level. The government has stated that environmental issues must consider in all future projects and developments in the country.

- Public sector

Malaysian government allocated several grants to develop a hybrid\ electric car. It was clear also that the government provides other incentives such as import duty and low taxes for Proton car. In the issue of promotion and helping the public to understand the importance of green technology, the government has tried to encourage the Malaysian to use products\ services produce less CO2.

- Private Sector

Even though the green car still in the testing process, CS1 showed that the company has made an extensive effort to develop a green car.

Table 4.1: Private Patterns of Analysis

No.	Phases	Description
1	Innovation (problem solving)	The development of the technology was focusing on alternative fuel, fuel Efficient and the engine. The outcome is Hybrid/ Electric Vehicle
2	Knowledge and skills required	Several programs launched by Proton to develop a green car such as: <ul style="list-style-type: none"> • staff transfers • secondment • special assignments to give global experience and corporate exposure Development of electric vehicles Program with Lotus
3	Investment	Proton will spend RM500 million on green technology vehicle research and development.
4	Marketing	Fleet Test Vehicle (FTV) Program The FTV program, in collaboration with KeTTHA and MITI, is a feasibility study to test PROTON's prototype EV Test Vehicle Program. Proton presented 5 units of Exora REEV and 3 units of Saga EV to be tested in specific locations It is designed to collect data for the future development of such vehicles and the infrastructural environment in which
5	Customer satisfaction	FTV program will enhance Proton's understanding of consumer's expectations and behaviors No clear evidence about the outcome of the program in terms of customer satisfaction.

• Society

As mentioned earlier in **Chapter 2** the last player in renewable energy is society. To make a decision on whether to purchase \ use or not is related to several factors. This research considers only three factors as mentioned in **Table 4.3** these that the researcher thinks they are very important in the case of Hybrid/ electric vehicle:

Table 4.3: Society Patterns of Analysis

No.	Phases	Description
1	Cost	Government support is needed to reduce the cost as the technology of the EV is relatively expensive. As the product still in the testing level, there is no clear evidence about the cost and how it is going to affect consumer's choice. CS1 showed that Proton needs to consider the price of other competitor in the market in the launch of its green car.
2	Quality and technology advancement	Some problem to be noticed here, from the customer perspective the technology is not sufficient comparing to hybrid car. Charging time is between 6 to 8 hours. Driving range less than expected, it is about 60 KM before going to charging station again. The infrastructure for charging station still not ready to commercialize the car in the market. Due to the quietness of the vehicle Pedestrian might not notice.
3	(awareness)	Even though the public are aware about the environmental issues, still the cost and the technology barriers consider as a priorities for the customers which need to be addressed in CS1.

ii) Key Findings

- Green technology in CS1 still in the developing stage.
- Size market is playing a major role in developing a green car.
- The cost\ investment in green car is too high which need to consider in relation with market size.
- The cost of developing EV can be seen in three stages, Cost of Technology (developing the battery and the engine) and Cost of the Infrastructure needed to support in the cities and public areas.
- In CS1 the government provided support to bring this project to life through grants for R&D.
- To make this project successful the government should provide fiscal incentives in launch of the product.
- Cost and technology usefulness are the main concern of consumers to by a green car, then comes the awareness towards the environment.
- CS1 has to work to launch the product as fast as possible as there is many companies have already launched their green car.
- The effort of Malaysian government in supporting a local green car is part of its commitment to reduce the CO2 level 40% by 2020.

iii) Summary of Case Study 1

CS1 has conducted in the Malaysia's first local car manufacturing Proton. The aim was to understand the efforts that the company is making to introduce its first green car to the Malaysian

market. As the product still in the developing stage there are some issues Proton should consider. Cost of technology, market size and some other competitors that already launched their green car in the market are the main threatens to the new product that Proton wants to introduce. If the company able to overcome these problem the launch of its product will mark a new era for the company, consumers and the country as well.

4.2 Case study 2

The second case study has conducted in Honda Malaysia. Honda is the first car manufacturer to introduce green in Malaysia. In 2012 Honda started to produce hybrid cars in its plant in Malacca. From this point Honda is leading the market share in terms of green car in Malaysia. All this highlights the importance of the company in the green business in Malaysia.

i) Case Study 2 Comparison with Theoretical Framework

The section is to outline the work of data collection of CS2 in relation with public sector, the company itself and the awareness of the society. CS2 showed the real practice of green car in the market. Honda introduced its first green car in 2003 since that time the company showed a great effort to support the environmental issue. Four hybrid models are currently in the market.

- Public sector

The beginning of green car to the public was in 2009. At that time it was difficult to the company to sell it product. The price was high. Only small number of consumers was able to buy a green car. It was like buying a luxury product more than buying an environmental product to reduce the GHG. In 2009, Malaysian government started to provide duty exemption on green car technologies. Honda has benefited from the incentives provided by the government to increase its market share in Malaysia.

Table 4.4: Public Sector Patterns of Analysis

No.	Phases	Description
1	Fund and fiscal incentives	No fund\ fiscal incentive have given to the company
2	Rules and regulations	Import duty and other incentives to encourage public to buy a green car
3	Promoting the concept of green technology to the public	Through its policies and regulations the government has pushed towards more green products. There is no specific program allocated to Honda, but the company still can achieve success.

- Private Sector

Being the first car manufacturer to bring green car to the Malaysian market, it helped the company to build its image in the mind of the consumers. Honda considers as one of the companies that put the environmental issues as a priority. Honda has won several prizes regarding its effort to reduce the CO2 in its products and the operation process as well. Parallel hybrid technology is used in Honda's green car. To have clear picture about this technology Appendix C explains the parallel hybrid in one of the Honda's car. **Table 4.5** summarize private sector in CS2.

Table 4.5: Private Sector Patterns of Analysis

No.	Phases	Description
1	Innovation (problem solving)	The technology used in CS2 is parallel hybrid
2	Knowledge and skills required	development of Honda Malaysia products are developing and testing in Japan, The work of Honda Malaysia staff focusing on assembling and related work. Honda Malaysia has launched a new program aiming to find the talented people to be developed and hired.
3	Investment	The establishment of line two (2) in its main plant to focus on producing Hybrid car. The cost of line two exceed RM300 million.
4	Marketing	extensive and aggressive market strategy in the media helped the company to lead the green car sector in Malaysia with 69% market share Honda realized that green technology is a new concept which requires more information to be provided to the costumers in fulfilling this issue the company have designed its web site to be more interactive to provide all the information about hybrid models.
5	Customer satisfaction	The design, price and simplicity of the technology helped Honda to be the first choice of green buyers

- Society

In CS2 the role of public has showed a clear effort to boost the work of the company to establish a new production line specifically for green car production. The company has shifted from assembling to produce hybrid car. It is worth noting that buying a green car might be seen for different perspectives and not only related to environmental issues. Buying a green car somehow still consider as a luxury practice and really need for some people. On the other hand, the factthat hybrid car are less fuel consuming attracts many people to buy green car even with high cost. **Table 4.6** outlines the main issues in this section.

Table 4.6: Society Patterns of Analysis

No.	Phases	Description
1	Cost	The cost of hybrid car is higher than internal combustion engine car.
2	Quality and technology advancement	The technology that is used in CS2 is parallel hybrid. Parallel hybrid is a combination between internal combustion engine and electric motor. The design of green car is different from traditional car. It is important to mention that Honda hybrid cars are heavier than traditional car due to the weight of the battery
3	Public awareness	As the company targeting a specific type of consumers, the concern about the environmental issues is slightly high. But still work need to be done to improve this aspect

ii) Key Findings

- CS2 showed a successful effort to promote the concept of green technology.
- Incentives provided by the government helped to flourish green car sector in Malaysia
- Honda dominant the green car market in Malaysia with 69%.
- Parallel hybrid is the best practice in this case study.
- Different market strategy have implemented in CS2, as the concept of green car is new more efforts need to be taken by car manufacturers.
- The low cost of developing green car have helped the company to flourish its business in
- Malaysia as the company developing its products for all over the world.
- The public awareness is not enough to build a solid demand for green products.

iii) Summary of Case Study 2

CS2 examined one of the most successful non Malaysian car manufacturers. The focus was to know how Honda different from other car manufacturer in Malaysia. The company introduced its first hybrid car in 2003. The resale was for testing and not for extensive use. 2009 marked wide use of green car in the Malaysian market with the incentives provided by the government. Honda showed a quick response through establishing line 2 in its main plant in Melaka to respond to increase in demand. Different marketing tools have used to bring customers to test the new concept of green car. The cost of hybrid car still expensive, Honda relying on its advanced technology and specific type of consumers to increase its market share.

4.3 Cross Case Comparison

This section is to highlight the analysis of the two (2) case studies base on the patterns of analysis. It is important to mention here that this section is not to compare which company is more successful than the other. The focus in this section is to see and examine different strategies and management style. Both Proton and Honda have their own characteristics and are targeting a different

market segment. Capabilities in terms of technology, brand and experience are also different which require the researcher to be very careful not to bias in this research and not to favor one company over the other.

Table 4.7: Cross case analysis

Governmental Role			
No.	Phases	CS1	CS2
1	Fund and fiscal incentives	√	
2	Rules and regulations	√	√
3	Promoting the concept of green technology to the public	√	
Private Sector			
4	Innovation (problem solving)	√	√
5	Knowledge and skills required	√	√
6	Investment	√	√
7	Marketing		√
8	Customer satisfaction		√
Society			
9	Cost		√
10	Quality and technology advancement		√
11	Public awareness		√

5.0 Conclusion

Emphasis on higher utilization of renewable energy is of utmost importance. Malaysia's effort in promoting renewable energy is commendable and has earned praises from many quarters. However, in order to maintain its status as one of the leading producers of renewable energies in the world, there are still several key areas in which it will need to improvise. Malaysia is a nation with limited conventional energy resources while it is blessed with multiple RE resources. These resources, such as biomass, biogas, mini-hydro and solar, should be utilized to ensure a more sustainable energy supply. Although renewable energy is starting to emerge as fifth fuel energy in Malaysia, it is not considered as a significant power source yet and RE is still in the beginning stage industry within the country.

The Malaysian energy sector is still heavily dependent on non-renewable fuels, such as fossil fuels and natural gas, as sources of energy. In line with the objective of diversifying the sources of energy, renewable energy has been identified as an alternative source of energy which could have been

promoted since the 8th Malaysian Plan, and while the Malaysian government has stimulated a variety of energy related policies and tried to sustain the energy demand the result is so far disappointing. In the 8th Malaysia Plan the Malaysian government fixed a target of 5% renewable energy of total energy in 2001-2005. The government declared the 9th Malaysian Plan having the target of 5% renewable energy of total energy. The 10th Malaysian Plan has pointed out that —several new initiatives anchored upon the Renewable Energy Policy and Action Plan will be undertaken to achieve a renewable energy target of 985 MW by 2015, contributing 5.5% to Malaysia's total electricity generation mix. This target is approximately the same as the 8th Malaysian Plan target, which means that Malaysia has implemented some incentive-led policies and projects in terms of renewable energy, and some progress of renewable energy has occurred.

5.1 Limitation of study

Two points to mark the limitations of this research which are sample of the study and data collection. The samples of this study are Proton and Honda. The results and findings could not be generalized to other companies due to the variance between companies in the automotive industry in Malaysia; however the research have achieved its goals by responding to the research aim through answering the research aim and research questions. The research can be used to spotlight on the automotive industry in Malaysia and how companies dealt with climate change issue. This study might provide the foundation for future research as well. For data collection, this research uses semi-structured interview as a method of data collection. Interview is a simple method of data collection. As this study achieved its aim about understanding the current situation of green technology in automotive industry, it should be highlighted that the result can be improve if more time have given during the interview session. As this research built on interview as a method of data collection, it is important to meet with those people how have the knowledge and the experience in the automotive industry in Malaysia, and in this case time offered is not enough to cover all the aspects of this research.

5.2 Recommendation

Several recommendations to be suggested to enhance renewable energy practice in Malaysia:

- Establishing new research centers and institutions to study renewable energy in Malaysia, and what is the suited practice in Malaysian environment. Analyzing data and information in renewable energy and energy efficiency help to promote green technologies in the country.
- More funding policies and mechanisms are required in the field of renewable energy. Universities and R&D centers should be part of this effort. The government should allocate more funds in the educational level.
- Malaysia should take the initiative to launch Green brand. Malaysia was very successful in launching —HALAL FOOD| brand. The researcher believe that Malaysia have the capabilities and the requirement to launch green brand that outlines the characteristics of green product\ service.
- In order to increase public awareness about the environment, programs that teach how to save the environment should be established in the schools and study institutions.
- Green exhibitions, trade shows dealing with green products\ services should be held regularly, marketing campaign should highlight the value of these products\ services.
- More attention should be given to green technologies in the process of technology transfer in Malaysia.

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