

**PROCEEDINGS ICE 2017 P110 – P128**  
**ISBN 978-967-0521-99-2**

**A STUDY ON THE POTENTIAL DEMAND FOR NATURAL GAS AS FUEL AMONG TAXI OWNERS IN KOTA KINABALU, SABAH.**

Adzmir Bin Abd Rahman, Caroline Geetha  
 Faculty of Business, Economics and Accountancy  
 Universiti Malaysia Sabah

**ABSTRACT**

The awareness on the benefits of natural gas as environmentally friendly, cheap, quality and convenient to use have an impact on the demand of Natural Gas among consumers. This study aims to identify and examine factors that influence market demand for natural gas among taxi owners in Kota Kinabalu. A total of 200 completed responses were collected in the survey. All respondents are drawn from Taxi owners' around Kota Kinabalu City. The survey was conducted with the collaboration of Sabah Energy Corporation Sdn. Bhd. (SEC)'s Business Development & Marketing Division and West Coast Taxi Owners' Association. SEC is a government link companies (GLC) with the main task to spearhead the development of energy particularly natural gas distribution and retailing in the State of Sabah.

**Keywords:** NGV, Taxi, CNG, Demand, Cost, Environmentally Friendly, Government Support, NGV

**1.0 Introduction**

Natural Gas (NG) can be considered as a new type of fuel for transportation industry in Sabah, Malaysia. Based on the success implementation of Natural Gas Vehicle (NGV) project in West Malaysia, natural gas is an ideal transportation fuel due to its characteristics such as cleaner and cheaper than traditional fuel like petrol, diesel and liquefied petroleum gas (JM Seisler 2015). When the entire cycle of producing, processing, transporting and using energy is considered, natural gas is proven to be highly fuel-efficient (International Gas Union 2009). The number of NGV has multiply globally. NGV Journal (2014) has ranked Malaysia as world's number 10<sup>th</sup> for number of NGV on its roads with approximately 55,999 vehicles in 2014.

According to Petronas NGV (2015), the development of Natural Gas Vehicle (NGV) in Malaysia was carried out by Petronas in 1986. In 1989, the Government approved the proposal to promote the utilization of NGV. The use of Compressed Natural Gas (CNG) was originally introduced for taxicabs and airport limousines during the late 1990s. With the availability of Peninsular Gas Utilisation (PGU) project, in 1991 Petronas was able to implement the initial NGV commercial program. Natural Gas is cheaper and environmentally cleaner than traditional fuel. In order to penetrate into traditional markets, it is imperative that gas utility company (gas distribution/retailing company) create comprehensive ecosystem for NGV consumers to support their NGV fuel requirement. Initial investment for such complete system is very costly and time consuming. Therefore, to mitigate potential investment risk, business losses and lower profitability, in-depth study to determine the availability of market and consumers' acceptance towards NGV is very crucial. Appropriate strategy to capture the market share of existing fuel is vital to ensure solid business proposal (Mohd. Suki 2013).

Taxis have been identified as one of the potential consumer for NGV if it is introduced in Kota Kinabalu, Sabah. NGV has been very successful in the West Malaysia since its introduction in 1991. In this respect, taxis would be ideal potential market for NGV initial development. Based on Sabah Economics Development and Investment Authority (SEDIA 2013) it is estimated that there are about 2000 taxis operating in the city of Kota Kinabalu that are currently running on traditional fuel. It is estimated the daily demand for such fuel is estimated at 100,000 liters of fuel per day which equivalent to approximately valued at RM 195,000 per day. Price advantage and environmentally friendly fuel are seen to be two major factors that could shift consumer (i.e. taxi driver) from traditional fuel to Natural Gas (Jayaraman, Hasnah, Chin Nor'Aini and Frank 2015). Thus, the focus of this study is to examine factors that will influence potential consumers i.e. taxi owners to switch to natural gas for their vehicle. This research will assist natural gas supplier or utility company i.e. Sabah Energy Corporation to understand natural gas demand factors of taxi owners operating around the city of Kota Kinabalu. Findings would provide fruitful insights for all the factors that enable natural gas utility company to prop up these factors as market tool to leverage on market demand among taxi owners.

### **1.1 Problem Statement**

Natural gas infrastructure is a capital intensive industry. Development of NGV infrastructure would require huge investment. The complete investment shall include complete NGV eco-system which includes the construction of fuelling stations, installation of compressors, investment in logistic vehicles, construction of natural gas pipeline and many more. In contrast Thong (2013) claims that the major barrier that exists for NGV is the availability of NGV refilling stations. The cost of building NGV stations requires twice the capital expenditure compared to building petrol and diesel stations (Thong 2013). To ensure business profitability and sustainability, managers are required to conduct in depth studies on the market availability and market acceptance towards natural gas. The purpose of this study is to identify the factors that influence the demand for natural gas as a fuel among taxi drivers in Kota Kinabalu.

### **1.2 Research Questions**

The overall research question is

What are the factors that can influence the demand for natural gas as a fuel among taxi drivers in Kota Kinabalu?

The specific research questions are as follow:-

1.2.2.1 Does price of natural gas influence the demand of natural gas among taxi drivers in Kota Kinabalu?

1.2.2.2 Does the characteristic of natural gas as an environmentally friendly product influence the demand of natural gas among taxi drivers in Kota Kinabalu?

1.2.2.3 Does the quality of the natural gas can influence the demand of natural gas among taxi drivers in Kota Kinabalu?

1.2.2.4 Does convenience to use natural gas as fuel influences the demand of natural gas among taxi drivers in Kota Kinabalu?

1.2.2.5 Does the support from the government to consume natural gas as fuel influences the demand for natural gas among taxi drivers in Kota Kinabalu?

### **1.3 Research Objectives**

1.3.1 The overall research objective of this study is to identify the factors that influence the demand for natural gas to be consumed as fuel among taxi drivers in Kota Kinabalu.

1.3.2 The specific research objectives are as follow:

1.3.2.1 To determine whether price of natural gas influences the demand FOR natural gas to be used as fuel among taxi drivers in Kota Kinabalu.

1.3.2.2 To determine whether natural gas which is classified as an environmentally friendly product influences the demand for natural gas as a fuel among taxi drivers in Kota Kinabalu.

1.3.2.3 To identify whether the quality of natural gas as fuel can influence the demand for natural gas among taxi drivers in Kota Kinabalu.

1.3.2.4 To identify whether convenience of using natural gas as fuel influences the demand of natural gas among taxi drivers in Kota Kinabalu.

1.3.2.5 To determine whether the support given by the government to consume natural gas influences the demand of natural gas as a fuel among taxi drivers in Kota Kinabalu.

## **1.5 Research Significance**

This study is of great significance as investment in NGV complete eco system is very costly. The capital expenditure (CAPEX) for the construction and installation of one NGV fuelling station (including 5km of pipeline) is approximately RM 18.4 Million (Seisler, 2015). In order to make sound business proposal, it is important for managers to determine the market availability and factors that affect consumers' (taxi owner) demand towards natural gas. Investment or capital expenditure (CAPEX) spent on the infrastructure has to be in line with the business profitability. This is to ensure that the interest of the stakeholders' are well taken care of and increases in value.

## **2.0 Literature Review**

### **2.1 Natural Gas for transportation**

Natural Gas Vehicle or NGV is a vehicle, which runs on natural gas. Consumers are seeking for alternatives to traditional fuel. The two forces environment and economics makes the development of Natural Gas for transportation important and urgent (IGU 2009). Despite the constraint to bring gas to the fuelling station the use of NGVs is growing around the world. In addition, many motor companies offer fleet vehicles which runs on natural gas, allowing consumers to convert their vehicles to natural gas.

Car, busses, trucks and trains that use Natural Gas as primary fuel are generally referred to as NGV. Meanwhile the fuel for NGV is typically called Compressed Natural Gas (CNG). CNG has been used in vehicles since 1930. CNG has successfully position itself as an alternative fuel to power various type of vehicles from light delivery trucks to full size urban buses (Ong, Mahlia, Masjuki, 2011). Most of the NGV engines used today are converted from gasoline engines with gasoline as a stand-by and it produces about 10–15% less power than the same engine fuelled by gasoline (Ong, Mahlia, Masjuki, 2011). Based on Material Safety and Data Sheet (MSDS) published by Sabah Energy Corporation (SEC), CNG is mainly consist of Methane CH<sub>3</sub>, compressed at high pressure of 250Bar and typically stored in a cylinders or vessels for storage in a fuelling station before it is transferred to a smaller cylinder in a vehicles. Natural gas is lighter than air and tend to disperse into atmosphere when leaks. CNG supply is accessible by customers from the total of 177 refuelling station throughout peninsular Malaysia. According to Thong (2013) one of the barriers that exist for NGV is the availability of NGV refilling stations. The cost of building NGV stations require twice the capital expenditure compared to building petrol and diesel stations (Thong 2013). The payback period is fairly long and it has been reported by NGV station operators. The regulated price for CNG is the main barrier to new entrants and expanding the service coverage. PETRONAS NGV Sdn. Bhd. is the only provider of CNG and its infrastructure is heavily concentrated in the Klang Valley.

**Diagram 1 – Refuelling Stations in Peninsular Malaysia**

Whilst the growth and development of a market for natural gas vehicles in Asia has been rapid, it has not been entirely without obstacles. According to the Blue Corridor NGV Rally 2016 the problems facing vehicles running on natural gas in Malaysia among others are overwhelming demand for natural gas infrastructure and fuel costs. Semin, Idris and Abu Bakar (2009) believe that in order to encourage NGV in Malaysia to further develop, natural gas infrastructure must be in place.

Accessibility of CNG Supply –  
177 Refuelling Station (Source  
– Petronas NGV Sdn. Bhd.)

## 2.2. NGV Market Demand and Environmentally Friendly

The International Gas Union - IGU (2009) reported that the transportation sector consumers are approximately 25% of world energy demand. According to NGV Journal (2015), Worldwide NGV Statistic shows that the total global Natural Gas Vehicle (NGV) population grew from 10.1 million vehicles in 2009 to 22.4 vehicles in 2016. Annual growth for Worldwide Natural Gas fuel for transportation from 2006 – June 2015 is approximately 485%. In 2015, worldwide fuelling station growth stood at 23% with the total of 26,629 stations. According to Thong (2013), Malaysia has developed an addiction to fossil fuel consumption, despite it is believed that Petrol and Diesel will suffer from price increase in the near future (Semin, Idris, Abu Bakar 2009). Semin, Idris and Abu Bakar (2009) claimed that public awareness on NGV initiatives is relatively low amongst the Malaysian public. Since fuel

replacement is an easy approach towards a greener mass transportation form, with midrange capital expenditures and awareness in this alternative can complement the development of NGV growth. The National Energy Balance – NEB (2013) stated that Malaysia currently produces 64,406ktoe (Kilo Tonne Oil equivalent) natural gas and consumes only 10.076 ktoe. Hence, there is plenty of natural gas available for automotive use.

CNG as fuel for transportation is a natural choice. It burns in a cleaner way than other fossil fuel that produces less Green House Gas (GHG) emissions. Seisler (2015) mentioned that vehicle generates less local pollution than other fossil fuel. NGV produces 97% less carbon monoxide, 99% particulate matter, 30% fewer greenhouse-gas (GHG) and 100% fewer evaporative emission than petrol and diesel. A consumer whose purchasing behaviour is persuaded by environmental concerns is known as a green consumer (Mohd. Suki, 2013). According to the US Environmental Protection Agency – EPA (2014) transportation sector contributed approximately 26% of the total GHG in the atmosphere. According to the UN report, marine ecosystems store up to 1.6 billion tons of carbon dioxide (CO<sub>2</sub>) every year, which is roughly equivalent to half the yearly emissions of the entire global transportation sector (Gunasingham, 2009). Gunasingham (2009) mentioned that the CO<sub>2</sub> emission rate of the transportation sector is 50% faster than CO<sub>2</sub> absorb by oceans. Thus, actions to reduce CO<sub>2</sub> emissions are highly regarded. Consequently, many developing countries including Malaysia have declared the commitment to reduce their CO<sub>2</sub> emissions.

### **2.3 Convenience and Safety of CNG**

Natural gas is very convenient and easy to use. The difference between traditional fossil fuel (petrol/diesel) and CNG is that the former is always in gaseous form. Similar to other fossil fuel, CNG can be purchased in any designated petrol stations (Malaysian Gas Association – MGA 2014). Natural gas is an abundant source of energy. NGV/ CNG sector is a well established industry with well developed technology. The technologies were often developed by industry leaders from decades of experience operating and manufacturing NG equipment. There are estimated 18 million NGVs worldwide and 24% are from Asia Pacific and America Latin (Khan, Yasmin, Khan 2015). With more and more fleet vehicles being converted to compressed natural gas operation, concerns have arisen about the safety of their fuel systems and the need for regulations to ensure safe operation (Khan, Yasmin, Khan 2015). Various safety and design requirements for CNG fuel system components are being used (Seisler, 2015). CNG is one of the safest fuel available in the market. This is due to the fact that most CNG equipment are certified and recognised by international standard bodies to ensure sound engineering practice (Seisler, 2015). CNG cylinders are designed and built of special materials to withstand high pressures with a factor of safety that is typically greater than two. Therefore it is stronger than typical petrol tank (Gas Research Institute 1996). Currently every new gas storage is thoroughly tested according to the applicable highest safety standard (Semin, Idris, Bakar 2009).

In addition, Physical properties of natural gas provide some safety benefits over gasoline and diesel fuel. The physical properties of CNG makes it inherently safer than diesel or gasoline (Khan, Yasmin, Khan 2015). Concern on the exposure to explosions is almost non-existent due to the fact that natural gas standard characteristic requires between 5% - 15% Lower Explosive Limit (LEL) of oxygen mixture before it could trigger an explosions (Semin, Idris, Abu Bakar 2009). In any fuel, including those used in motor vehicles, can be dangerous if handled improperly. Petrol or diesel is a potentially dangerous fuel, but by understanding how to handle it, we have learned to use it safely. The same is true of natural gas (Khan, Yasmin, Khan 2015).

## **2.4 Consumers Purchasing Decision based on Environmental Issues**

A consumer whose purchasing behaviour is persuaded by environmental concerns is known as green consumers (Mohd. Suki 2013). Consumer's environmental concerns are related to the interest towards physical condition of environment and its problem. According to Mohd. Suki (2013), consumers environmental concerns awareness of green product, price and brand image influence their purchasing decision. Based on the study done by Mohd Suki (2013), price and brand image has the strongest factors on consumers' decision to purchase environmentally friendly product. Therefore, Mohd Suki believed that with strong representation of green branding image and strategically undertake awareness program for targeted market segment. Despite substantive number of research works conducted on consumers' characteristic, yet there is no agreement about the "true" profile of green consumers (D'Souza et al 2007). Lee (2008) stated that there are minimal studies on the green marketing issues in Asian countries, including Malaysia. Kumar M (2013), concluded that a well-implemented awareness on green brand identity should provide benefits to environmentally conscious consumers. However, the perceived customer benefits may be insufficient as a motivating factor for awareness on green brand identity purchase (Belz and Dyllik, 1996). The basic idea is that customers are provided with information on the environmental issues in the marketing effort of CNG and they can use this information while deciding fuel to purchase.

## **2.5 Cost and quality of CNG**

Price of fuel is the attribute that consumers reflect on when making a green-purchasing decision (Mohd. Suki, 2013). According to Sahari (2006) there are three major factors that motivate consumers. The factors are availability, cost and supply (Sahari 2006). As traditional fuel subsidies were gradually removed since the year 2008, the subsequent 41% price hike on petrol and diesel led to drastic increase in the number of new NGV in Malaysia (Ong, Mahlia, Masjuki 2011). When CNG was introduced in 1989, the price set was deemed sufficient to cover cost of production and profits. However, the current price is insufficient to cover the cost of production. In 2013, PETRONAS had subsidised an accumulated amount of RM3 billion for CNG (Ong, Mahlia, Masjuki 2011).

Price of CNG has been always cheaper by 30 - 50% than traditional fuel such as petrol or diesel (Seisler 2015). This shall be a major attribute for taxi owners to convert to CNG from traditional fuel. Based Mohd Suki (2013), consumers' decision to purchase environmentally product is highly influence by its cost, which signify the low price makes better buy. Based on research done by Jayaraman, Haron, Feng, Yusof and Agbola (2015), potential consumers in the Klang Valley were willing to switch from petrol to CNG only when the petrol price remained at RM2.10 / liter. Petronas NGV 2016 reported that the current price of CNG is RM 1.05 per liter. Therefore the estimated saving is 44.7% as compare to petrol in Dec 2016.

In terms of fuel quality, the use of CNG could reduce noise pollution from quieter engines which entail improvement in engine combustion i.e. complete fuel burning (NGV Journal 2013). Dedicated NGV can provide range up to 500km and bi-fuel (converted Petrol to NGV vehicle) NGV can reach between 200KM to 500km (GNV Magazine 2014). In Peninsula Malaysia, public refuelling stations are commonly available and the refuelling time varies from 3 to 15 minutes (Jayaraman, Haron, Feng, Yusof and Agbola 2015). Natural gas engine technologies can differ in the method used to ignite the fuel in the engine cylinders, the air-fuel ratio, the compression ratio, and the resulting mixed performance and emissions capabilities (US Department of Energy 2015). Natural gas occupies a considerably larger storage volume per unit of energy at atmospheric pressure than refined petroleum liquids; it is stored aboard the vehicle as either a compressed gas or a liquid. The storage requirements are still much greater than those for refined petroleum products, which increases vehicle weight and tends to reduce fuel economy (US Department of

Energy 2015). Based on studies by Jayaraman, Haron, Feng, Yusof and Agbola (2015), some respondent felt that the gas cylinder is bulky, making the boot of the car smaller from the original designed for and the trunk space will become limited after installing the gas storage cylinder. According to IGU (2012), the underlying challenges on quality issues that need to be addressed are as follow;

Issues on high maintenance costs, availability of spare part and maintenance centres, where high maintenance was due to incompatible retrofitting of petrol engine on NGV conversion kit.

Public perception that NGVs are not at par on engine performance compared to their petrol and diesel counterparts.

## **2.6 Government Support and Initiatives**

Government initiative refers to support given or initiative actions taken by the national government (Diekmeyer, 2008). This means that government plays an important part in the development of NGV ecosystem and all the initiative efforts taken by government is vital. The Malaysian government has implemented a few initiatives to encourage the use of CNG as an alternative fuel (Semin, Idris, Bakar 2009) such as reduction of road tax 50% and tax incentives to encourage purchase of new NGV as well as sales tax on NGV conversion kits that ultimately reduces capital costs to the owner. Based on research conducted by Ong, Mahlia and Masjuki (2011) the demand for natural gas vehicles (NGVs) has dramatically increased through changing government policy and the increased appeal of NGVs to consumers. However, much like the rapid expansion of any development, it can be left stretched without full investment.

Governments should play more efforts in promoting the usage of CNG for vehicle in order to continuously raise their awareness towards environmental issues. In the budget 2011 the government established the green technology financial scheme of USD0.63 billion to provide soft loan for user and producer of environmentally friendly product such as CNG or NGV (Jayaraman, Haron, Chin, Yusof, Agbola, 2008). As the role model to all people in the country, Tan et al. (2010) indicated that Malaysian government has implemented various strategies for sustainable consumption and development. In addition, Haron, Paim and Yahaya (2005) said that Malaysian government choose to use social advertising to educate and foster environmental awareness and concern among the public. Government should launch a campaign to promote consciousness on the environmental protection activities such as “go-green” campaign, “Earth Hour”, and others campaign activities to reduce the burden of environmental.

## **2.7 Theory of Reasoned Actions (TRA)**

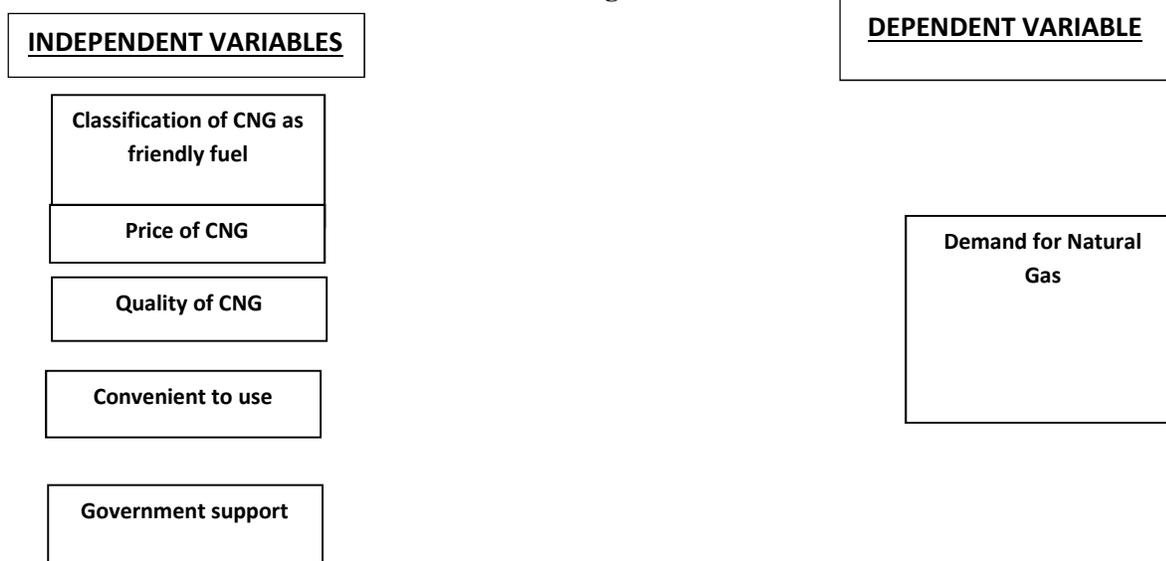
Ajzen and Fishbein (1975) suggested two factors that determine intention: attitudes and subjective norms. Theory of Reasoned Actions (TRA) is a theory that observes how consumers’ attitudes are formed and how people could influence their behavior. Therefore, in this study the TRA model is used to discuss on how the taxi owners attitude towards the environmental issues, cost, convenience, quality and government support could affect their buying behavior and action (Fishbein and Ajzen, 1975). Baker and Ozaki (2008), Gupta and Ogden (2009), and Kalafatis, et al. (1999) all applied this theory in different field to analyse human’s behavior. TRA is also referred to extensively and used to explore consumers’ purchasing intention (Lee and Green, 1990). This means an individual have decided to engage certain behavior that will convert his or her intention into action in an appropriate opportunity and right time.

### 3.0 Methodology

#### 3.1 Research Framework

The theory of reasoned action (TRA) proposed by Azjen and Fishbein (1980) has been used to develop a research framework to determine the influence the preference of environmentally friendly proposition, fuel cost and the intention of respondents to switch from petrol to CNG. The research framework has been constructed to conceptualise the intention of using NGV as an alternative to petrol car based; 1) on the relationship of classification of environmentally friendly fuel and demand on CNG; 2) on the relationship of the price of CNG and demand on CNG; 3) on the relationship of the quality of CNG and demand on CNG; 4) on the relationship convenient to use and demand on CNG; 5) on the support provided by the government and demand on CNG

Diagram 2



#### 3.2 Statement of Hypotheses

The following hypotheses statements were formulated to answer the research questions:

H1a- The price of CNG can influence the demand of natural gas as a fuel among taxi owners in Kota Kinabalu.

H2a- CNG as an environmentally friendly product can influence the demand for natural gas a fuel among taxi owners in Kota Kinabalu.

H3a- The quality of CNG can influence the demand of natural gas as a fuel among taxi owners in Kota Kinabalu.

H4a- Convenient to use CNG as fuel can influence the demand of natural gas as a fuel among taxi owners in Kota Kinabalu.

H5a- Support from the government can influence the demand for natural gas as a fuel among taxi owners in Kota Kinabalu.

#### 3.3 Research Design

In collecting relevant data survey methodology is considered useful in descriptive and correlation studies because of it's versatility and efficiency, the extent to which the results of this study hold true for groups that did not participate in this research. Through a descriptive survey method, data was gathered and

collected from specific questionnaire. Survey method is based on primary data collection technique. This method is useful in describing characteristic and behaviour of targeted taxi owners. Among others, the advantages of descriptive survey method were high accuracy results, flexible and enable for large amount of information. This survey also offers a reasonably quick, inexpensive, efficient, and accurate means of ascertaining the characteristics, knowledge, attitudes, and behaviour of the taxi owners in Kota Kinabalu. In this research, a cross-sectional survey was adopted as the research design due to the fact that the study was based on observational study that analyses data collected from targeted group of sample using questionnaire instrument made at a single point in time. The research design also entailed causal-comparative or quasi-experimental methodology, that identifies cause-and-effect relationships between independent and dependent variables that influences the decision to switch to an environmentally friendly fuel i.e. Natural Gas.

### **3.4 Operational Definition**

Operational is defined as terms of specific criteria for testing or measurement (Cooper and Schindler, 2014). An operational definition is how the researchers decide to measure variables in the study. For all types of research design participants must be chosen, where, 1) the whole population of the taxi owners in Kota Kinabalu was described as the entire group of interest; 2) Targeted sample is a portion of the taxi owners population selected for the study; 3) random selection was selected from the sample of population; The term of specific criteria for this study was the variables that used to be measured. The terms were environmentally friendly fuel, cost of CNG, quality of CNG, convenient to use and government support as explained below.

#### **Environmentally Friendly Fuel**

Environmentally friendly fuel, is fuel that do very little damage to the environment. It helps user to reduce potential pollution when utilised. The use of other fossil fuel for transportation burns more Green House Gas (GHG) that contributed to pollutant being release to the environment.

#### **Price of CNG**

The price of CNG is the cost of CNG for the end users i.e. taxi owners. Usually cost of CNG is measured in litre per equivalent petrol. It is known that CNG has always been lower than other fossil fuel due to the fact that natural gas is a by-product of petroleum that requires less processing during its production. The cost of fuel has a great influence toward consumer's decision to switch to natural gas. Despite limited range, NGV can run due to its small storage cylinders installation, consumers consider CNG as a cheaper option should the price of petrol raised to a point that it is no longer affordable.

#### **Quality of CNG**

Quality is a function of how consumers perceive or view the product or services they receive. Consumers always compare what they expect with what they actually receive. Therefore quality is a perceptual somewhat subjective attribute and maybe understood differently by different people. Quality of CNG is very much the same from one location to another. Some consumers perceive that prolong use of CNG could cause damage to the engine. Others think that CNG could give them extra miles that they needed to go for a long journey. Overall, there are mixed feeling about the usage of CNG, therefore the study will help to determine the actual perception of taxi owners toward the quality of CNG.

**Convenience of CNG**

CNG is very easy to use. Handling of CNG takes little thought, is routine, frequently purchased and consumers purchase with little planning. With the development of additional Petrol Station equipped with CNG refuelling station, the supply of CNG would be very easy to get. Current technology allows refuelling process easier to handle. Due to strict regulatory requirement, CNG/NGV is the safest fuel available in the market.

**Government Support in terms of financial and other incentives**

Starting and growing NGV business can be challenging. Therefore in order to help the business or industry to grow support from the government is very crucial. Help from the government might include financial support, tax incentives, favourable policies on the industry, grant etc. Companies might be eligible for support if it is just starting business in an economically disadvantage industry. Ultimately, the government aim to make businesses to prosper and create additional employment hence more taxes will be collected from the industry players.

**3.5 Measurement of Variables/Instrumentation**

Data collected from respondents through questionnaire were measured based on certain measurement scale. The four measurement scales are nominal, ordinal, interval and ratio scale (Zikmund et al., 2010). A scale of measurement is a tool to measure variables by specifying a range of score. In this study four levels of scale measurement were used and they are as follow. Demographic profile in Part A such as gender and age were measured based on nominal scale. This is due to the fact that data of 'male' and 'female' are not in ordering form as well as age classification. Hence, there are six questions in Part A apply nominal scale which are question no 1, 3, 4, 5, 6, 7, and 8 in the Questionnaire Form in the Appendix 1. Question 3 applied ordinal scale of measurement. Question 3 in part A was about income of respondent. Changing the response format to numbers does not change the meaning of the scale. For example, ordinal scale will be used in the monthly income because the data were in order form for the researcher to know the actual monthly income. According to Cooper and Schindler (2014), Likert scale is the most commonly used variation of the summated rating scale. Likert scale is easy and quick to construct where each response is given a numerical score to reflect it degree of attitudinal favourableness (Cooper and Schindler, 2014). For example, Likert scale rank from "Strongly Agree", "Agree", "Neutral", "Disagree" and "Strongly Disagree" and assigned them with numerical order from 5 to 1. All the questions in Part B were measured and collected based on Likert scale as a scale of measurement. This is where the range is from 5 to 1; 5 - strongly agree, 4 - agree, 3- neutral, 2 – disagree and 1-strongly disagree. Data collection approach was conducted through questionnaire method. The questionnaires were distributed with the collaboration of Sabah Energy Corporation Sdn. Bhd.'s Business Development and Marketing Division as well as with the help of West Coast Taxi Association. 200 questionnaires had been distributed to group of taxi owners around Kota Kinabalu city which represent all the taxis that operating in the city. In addition, the survey was conducted in the interest of Sabah Energy Corporation Sdn. Bhd. as the gas utility company to gather information and analyse the potential market for NGV/CNG development. Therefore, the whole survey exercise was conducted with the permission of the Divisional Head of Business Development and Marketing Division of the organisation as well as the getting a consent from the President of the Taxi Owner association (Hj. Kani). The questionnaires were in Bahasa Malaysia this was to ensure the entire respondent able to answer all the questions comfortably as majority of the Taxi owner are Malay speaking individual.

### 3.6 Data Collection Procedures

Prior to the actual survey exercise, 30 questionnaires were distributed among the respondents. Upon completion all the questionnaires were collected and processed in the SPSS or PSPP open source for further analysis. Where the purpose of this pilot test to ensure the feasibility, reliability and validity of the proposed study design (Thabane et al,2010) based on the result test of inter-item validity, face validity, and Cronbach's alpha. As for the result, data were analysed based on Cronbach's alpha figure and the result are as follow:

**Table 1: Reliability Test Results**

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.717	.891	27

The reliability of data is determined by Cronbach's Alpha Coefficient Value. Table 1 shows the rule of thumb for Cronbach's Alpha Coefficient Value. The data with the Cronbach's Alpha value more than 0.6 was acceptable.

## Result and discussion

### 4.1 Descriptive Analysis

#### 4.1.1 Demographic Profile

Demographic profiles of respondents were shown in Table 2 below which is the frequency distribution of gender, age, ownership, income, fuel cost and type of fuel.

**Table 2: Respondent Profile**

Description	Value
N	200
<b>Age</b>	
Age Mean	42.38
Age Standard Deviation	8.49
Minimum Age	25
Maximum Age	60
<b>Gender</b>	
Male	99.50%
Female	0.5%
<b>Fuel Type</b>	
Petrol	100%
Diesel	0%
<b>Ownership</b>	
Rental	1%
Owner	99%

Table 2 showed that among the 200 respondents 99.5% were male and 0.5% were female. This was due to the fact that taxi drivers were culturally and traditionally a male dominated sector. Based on the above table, 99% of the respondents consist of taxi owners and 1% consists of taxi driver on vehicle rental basis. The highest age was 60 years old and the lowest age was 25 years old. Mean age for all respondent was 42.38 with a standard deviation of 8.49. 100% of the respondents were using petrol for their vehicle. 99% of respondents were drivers cum owner of the vehicles.

**Table 3: Net Income Profile**

Description	Value
N	200
Mean	2967.95
Standard Deviation	814.14
Minimum	1200
Maximum	6000

Based on the above table the minimum and maximum net income were RM1200 and RM6000 respectively. Income mean was 2967.95 with standard deviation of 814.14. This means that the data were not close to mean value and indicates that net income of taxi owner very much varies. From the table it can be established that that all respondents were well above the minimum wages and most importantly above the poverty line set by the government.

**Table 4: Fuel Cost**

Description	Value
N	200
Mean	688.45
Standard Deviation	230.38
Minimum	300
Maximum	2000

Respondent fuel profile was shown in Table 4. Maximum fuel cost was RM2000 and minimum fuel cost was RM300. The result showed that the mean fuel cost was RM688.45 with standard deviation of RM230.38. Based on the above table, approximately 23.2% of the mean net income goes to fuel cost.

### 4.3 Statistical Analysis

Statistical analysis is a science of collecting, exploring and presenting large amount of data to discover underlying trends and patterns. In exploring the data collected from respondents the statistical results of variables are interpreted in descriptive statistics, reliability test, correlation analysis and multiple linear regression analysis and normality test.

#### 4.3.1 Descriptive Statistics

Descriptive statistics determined mean and standard deviation for independent variables and dependent variable. Descriptive analysis also refers to a set of scientific methods and procedures to identify and describe the existing characteristics of a target population. Descriptive statistic used to summaries the characteristic of the data. Descriptive Statistics are used to present quantitative descriptions in a manageable form. Descriptive statistics for independent and dependent variables are measured in Likert Scale as shown in Table 5.

**Table 5: Descriptive Statistics**

Description	Mean	Standard Deviation
Demand for CNG(Would like to use NGV)	4.07	0.6
Classification of CNG as an Environmentally Friendly fuel	3.43	0.63
Price of CNG	3.74	0.63
Quality of CNG	3.98	0.67
Convenient to use	3.69	0.71
Government support	2.64	0.69

The above table shows that, dependent variable demand for natural gas has the value mean of 4.07 with standard deviation of 0.6 which indicates that most of the respondents are inclined to use natural gas for their taxi. Meanwhile in measuring the independent variable environmentally friendly factor measured mean of 3.43 with 0.63 of standard deviation. This value significantly suggested that the respondents are quite unsure that CNG is an environmentally friendly fuel. On the pricing of CNG, the survey results show that the respondent are quite agreeable that price of CNG is cheaper than other fuels with the value of mean 3.74 with standard deviation of 0.63. In terms of quality of CNG the results shows mean of 3.98 with standard deviation of 0.67. This suggests that most respondent were quite agreeable that the quality of CNG is quite satisfactory. In the survey, respondents were asked if CNG is easy to use, the results measured mean of 3.69 with standard deviation of 0.71. Hence, this indicates that most of the respondents are uncertain whether CNG is easy to use. The survey also asked a set of questions on the availability of government support to the development and usage of NGV/CNG. Most of the respondents agree that there is not enough support received from the government for taxi owners. This suggests that they were not certain of the support by the government on the usage of CNG. The results shows that independent variable “government support” measures mean of 2.64 with standard deviation of 0.69.

#### 4.3.2 Reliability Test

Reliability test is a measurement obtained by administering the validity and reliability of the data collected from the taxi owners. The results of reliability test for each variable have shown in Table 6 (a – f) meanwhile Table 8 shows the overall results of the reliability test of the study.

**Table 6a : Reliability test for demand for natural gas.**

Cronbach's Alpha	N of items
0.8	4

The above result indicates that the demand of natural gas has a very good strength of association. This suggests that, all the questions provided in the questionnaire on demand for natural gas are correlated to each other.

**Table 6b : Reliability Test for Environmentally Friendly Fuel**

Cronbach's Alpha	N of items
0.73	4

The above result shows that environmentally friendly fuel has scored quite a good strength of association. This indicates that, the questions on environmentally friendly were correlated with each other.

**Table 6c : Reliability Test for Price of CNG**

<b>Cronbach's Alpha</b>	<b>N of items</b>
0.73	4

The above result indicates that the Price of CNG has a good strength of association. This suggests that, all the questions provided in the questionnaire on Price of CNG were correlated to each other.

**Table 6d : Reliability Test for Quality of CNG**

<b>Cronbach's Alpha</b>	<b>N of items</b>
0.78	3

The above result shows that quality of CNG has scored quite a good strength of association. This indicates that, the questions on quality of CNG were correlated with each other.

**Table 6e : Reliability Test for Convenient to use CNG**

<b>Cronbach's Alpha</b>	<b>N of items</b>
0.83	4

The above result indicates the Convenient to use CNG has a good strength of association. This suggested that, all the questions provided in the questionnaire on convenient to use CNG were correlated to each other.

**Table 6f : Reliability Test for Government support**

<b>Cronbach's Alpha</b>	<b>N of items</b>
0.93	4

The reliability test for Government support of CNG scored a very good association. This entails that Government support of CNG questions were highly correlated with each other.

**Table 7: Reliability Test for overall results**

<b>Cronbach's Alpha</b>	<b>N of items</b>
0.90	22

Ultimately, the above table indicates that the overall result of reliability test Cronbach's Alpha value is 0.90 which indicates a very good association and correlation between all variables. Hence, the measured variables are reliable with a firm and consistent result. Therefore, all of the items are acceptable for further analysis.

#### **4.3.3 Correlation Analysis**

Correlation analysis was used to evaluate the research strength of relationship between two, numerically measured, continuous variables. Pearson's correlation coefficient is a measurement of linear association. Correlations measure how variables are related. In other words, correlation analysis measured the degree of change in one variable will associated with the changes in another variable. The correlation between variables can either be weak, strong or perfect positive or weak, strong or perfect negative.

**Table 8: Correlation Matrix Independent and Dependent Variables**

Correlation	Demand for NG	Environmentally Friendly Fuel	Price of CNG	Quality of CNG	Convenient to use	Government Support
Demand for NG	1	0.41*	0.63*	0.46*	0.43	0.16 0.025 (2 tailed)
Environmentally Friendly Fuel	0.41*	1	0.43*	0.30*	0.42*	0.23 0.001 (2 tailed)
Price of CNG	0.63*	0.43*	1	0.32*	0.33	0.14 0.05 (2 tailed)
Quality of CNG	0.46*	0.30*	0.43*	1	0.74	0.27*
Convenient to use	0.43*	0.42*	0.33*	0.59*	1	0.35*
Government Support	0.16 0.006 (2 tailed)	0.23 0.001 (2 tailed)	0.14 0.05 (2 tailed)	0.27**	0.35*	1

\* Correlation is significant at 0.0001 (2 Tailed)

Based on Table 8, price has a strong positive relationship with demand of CNG. Convenient to use and quality of CNG also has a strong positive relationship measuring at 0.74. Meanwhile, government support has a weak positive relationship with the demand of CNG. In addition, Price of CNG has a weak positive relationship with government support on the use of CNG. Correlation analysis was done to verify the validity of the regression. Based on Table 9, the value of correlation coefficient for all variables are less than 0.95 and there is no multicollinearity occurs among the variables.

#### 4.3.4 Multiple Linear Regression Analysis

Regression analysis is a predictive analysis. The multiple linear regression is used to explain the relationship between one continuous dependent variable from two or more independent variables. In this study it is used to measure the relationship between independent variables and dependent variable. Table 9a, b and c showed the results of multiple linear regression.

**Table 9a: Predictor (Environment, Price, Quality, Convenient, Government)**

Model	R	R Square	Adjusted R Square	Std error of the estimate
1	0.7	0.49	0.48	0.43

Based on Table 9a, the value of  $R^2$  of 0.49 showed that 49 percent changes in demand of natural gas among the taxi owners was influenced by environment, price, convenient, quality and government support. The balance of 51 percent changes in the demand for natural gas among taxi owners in Kota Kinabalu was influenced by other factors.

**Table 9b: Model Summary – Analysis of Variance (ANOVA)**

Model	Sum of Square	df	Mean Square	F	Sig.
Regression	35.44	5	7.09	37.55	.000
Residual	36.62	194	0.19		
Total	72.06	199			

Table 9b showed the execution for Analysis Variance (ANOVA) where the F-Statistics value of 37.55 ( $p < 0.05$ ) shows that the null hypothesis was accepted or cannot be rejected. This mean the data fits the model.

**Table 9c: Coefficient Value of Variables**

Model	B	Standard Error	Beta	T Value	Sig.
<b>(Constant)</b>	0.95	0.25	0.00	3.88	0.000
<b>Environment</b>	0.09	0.06	0.09	1.49	0.138
<b>Price</b>	0.47	0.06	0.49	8.43	0.000
<b>Quality</b>	0.19	0.06	0.21	3.25	0.001
<b>Convenient</b>	0.10	0.06	0.12	1.76	0.08
<b>Gov. Support</b>	-0.03	0.05	-0.03	-0.55	0.585

Table 9c shows coefficient values for the variables. The estimated t-values of environment and convenient are 1.49 and 1.76 with ( $p = 0.32$  and  $0.08$ ) respectively. This means the null hypothesis was rejected at 5 percent significance level. There was enough statistical evidence that indicate environment and convenient influences demand for natural gas among taxi owners in Kota Kinabalu. The t-value for price was 8.49 ( $p=0.00$ ). This means the null hypothesis was rejected at 5 percent significance level. There was a very strong statistical evidence that price has a big influence on natural gas demand among taxi owners in Kota Kinabalu. In terms of quality, the t-value was 3.25 ( $p=0.00$ ). This means the null hypothesis was rejected at 5 percent significant level. This statistically indicates that quality has a greater influence on natural gas compared to environment and convenient among taxi owner in Kota Kinabalu. Government support has a negative relationship with demand for natural gas with estimated t-value of -0.55 ( $p = 0.585$ ) which means the null hypothesis cannot be rejected at 5 percent of significance level. Government involvement in the development and promotion of the use of CNG/NGV had no influence in the demand for natural gas. In brief, taxi owners in Kota Kinabalu were not influence by the government support to convert to natural gas.

#### 4.3.5 Normality Test

A normality test was used to determine whether sample data has been drawn from a normally distributed population (within some tolerance).The test was used to determine if a data set was well-modeled by a normal distribution and to determine how likely it was for a random variable underlying the data set to be normally distributed. Table 10 showed the result of normality test. The test was based on Skewness and Kurtosis, Kolmogorov-Smirnov and Shapiro-Wilk statistics. If the significant level was greater than 0.05 the data was normally distributed. Data that would be normally distributed if the significant level was greater than 0.05 for Kolmogorov-Smirnov statistics. Since all the data has a probability value of greater than 0.05, it can be concluded that all the data were normally distributed.

**Table 10 : Result of Normality Test**

Valid cases = 200; cases with missing value(s) = 0.

<i>Variable</i>	<i>N</i>	<i>Mean</i>	<i>Std Dev</i>	<i>Kurtosis</i>	<i>S.E. Kurt</i>	<i>Skewness</i>	<i>S.E. Skew</i>	<i>Minimum</i>	<i>Maximum</i>
Demand for CNG	200	4.07	.60	1.24	.34	-.67	.17	1.50	5.00
Environmentally Friendly	200	3.43	.63	.68	.34	-.41	.17	1.00	5.00
Price of CNG	200	3.74	.63	.68	.34	-.39	.17	1.25	5.00
Quality of CNG	200	3.98	.67	.63	.34	-.70	.17	1.67	5.00
Convenient to use	200	3.69	.71	.82	.34	-.63	.17	1.25	5.00
Government Support	200	2.64	.69	.21	.34	.29	.17	1.00	5.00

## 5. 0 Conclusion and Recommendation

### 5.1 Conclusion

The key findings of this study are as follow:-

The quality and price of CNG were both significant factors that influence demand of natural gas among taxi owners in Kota Kinabalu. Some studies suggested that price of fuel was the attribute that consumers reflect when making decision to purchase environmentally friendly product. As pointed out by Mohd Suki (2013) that consumers' decision to purchase environmentally friendly product was influenced by its cost also in line with the key finding in this study. Most respondents believed that the price of CNG was cheaper than petrol, this statement was in line with Seisler that price of CNG has been always cheaper than other traditional fuel. The study also established that taxi owners were not willing to pay higher price for environmentally friendly product or fuel.

In terms of quality, some studies show consumers will get smaller boot space and lesser power from their NGV. These reasons will not deter taxi owner to convert to NGV. This might be due to the fact that, most respondent received positive feedback from their counterpart (Taxi Association) in West Malaysia.

Meanwhile, both environmentally friendly and the convenience of CNG did not have significant influence on the demand for natural gas among taxi owners in Kota Kinabalu. Based on the study done by Mohd Suki (2013), price and brand image has the strongest factors on consumers' decision to purchase environmentally friendly product. Findings from this study showed that environment does not really give an impact to their decision in converting to natural gas. This was supported through study done by Belz and Dylink (1996) suggesting that the perceived customer benefits may be insufficient as a motivating factor for awareness on green brand identity purchase.

In terms of government support most respondents were not convinced by the effort promoting the use of CNG/NGV. From the study the government support factor will not influence taxi owner to convert to CNG/NGV. It shows that, the government's effort to promote the usage of CNG/NGV has little impact on the demand of CNG. This statement can be related to some study in the literature review where according to Semin, Idris and Abu Bakar (2009) public awareness on NGV initiatives was relatively low amongst the Malaysian public.

## 5.2 Recommendation

The results of this study provided opportunity for business managers to promote CNG based on the factors. Business managers were recommended to focus on the organisations' brand awareness on its product i.e.CNG association with low price and high quality product proposition. It was important to note that in promoting the use of CNG to the consumers, factors like environment, convenience and government support does not have any influence among taxi owners' decision. If CNG was introduced in Kota Kinabalu, taxi owners will be the first transportation consumers to use natural gas. Awareness regarding pricing and other salient features of CNG such as high quality will help business managers to capture new market of NGV users in Kota Kinabalu.

In order to strengthen the organisation marketing strategy, business managers should also use their existing (industrial and commercial) customers' testimonial and experience with natural gas. This is to encourage new customers like taxi owner to switch from traditional fuel to CNG. In order to leverage the marketing effort, business managers should also emphasize onCNG stewardship and promotion. This was due to the fact that evolving and changing consumers' views will drive CNG product development in order to harness new potential in CNG market thus increase company's bottom lines while satisfying the customers' base.

In terms of government support, relevant authorities such as Jabatan Pengangkutan Jalan (JPJ), Kementerian Perdagangan Dalam Negeri Koperasi dan Kepenggunaan should intensified its promotion effort in order to increase the awareness of consumers on government incentives when using natural gas. Based on the result of this study, it found that most taxi owners were not aware of any government incentives that were currently available.

## References

- Barkawi Sahari, 2006. Compressed Natural Gas Passenger Vehicle Development Issues and Challenges.
- Dr. Jeffrey M. Seisler (2015). NGVs in their Global Context: Opportunities, Challenges, & Strategies. *Clean Cities Transportation: A Workshop for Israeli Policymakers on the proper use of Compressed Natural Gas (CNG) in the transportation sectors.*
- Dr. Xander Thong.(2013) Case Study: Malaysia Natural Gas as Fuel Replacement Therapy for Petrol/Diesel Addiction.*ESCAP United Nation.*
- Dr. A. W Karim (2009). Natural Gas as a Transportation Fuel The alternative choice for cleaner energy. *Report for International Gas Union.*
- H.C Ong, T.M.I Mahlia, H.H Masjuki (2011) A Review on Energy Pattern and Policy for Transportation Sector in Malaysia. *Renewable and Sustainability Journal Review.*
- Land Public Transport Commission Malaysia (2011).*Greater Kuala Lumpur Land Public Transport Master Plan.*
- Jalal Mengat Muhammad Adlan Abdullah, Muhamad Ghadaffi Mohd. Noh, Faridon Idris (2006) Evaluation of Bi-Fuel NGV Vehicle For Utilisation of Natural Gas as The Alternative Fuel. *Petronas Research & Scientific Services Sdn. Bhd. 4<sup>th</sup> Asian Petroleum Technology Symposium.*

- Jayaraman, Hasnah Haron, Chin Kim Feng, Nor'Aini Yusof and Frank Agbola. (2015). Determinants of The Intention to Use a Natural Gas Vehicle (NGV) as an Alternative to a Petrol Car: The Case of Malaysia. *Journal of Sustainability, Science and Management*.
- Norazah Mohd. Suki. (2013). Green Awareness Effects on Consumers' Purchasing Decision: Some Insights from Malaysia.
- Nusaibah Mansor, Siti Norbaya Yahaya, Nurul Zarirah Nizam & Yasuo Hoshino (2013) Consumers' Acceptance towards Green Technology in Automotive Industries in Malacca, Malaysia. *International Journal of Business Administration*.
- Malaysian Energy Information Hub Unit (2015). The Energy Commission. *Malaysia Energy Statistics Handbook. 2015*.
- Semin, Awang Idris and Abu Bakar. (2009). An Overview of Compressed Natural Gas as an Alternative Fuel and Malaysian Scenario. Research Gate.
- Sheik M. Isaacs (2015). Consumer Perceptions of Eco-Friendly Products. *Walden University Dissertation and Doctoral Studies*.
- Siti Indati Mustapa, Hussain Ali Bekhet (2013). Investigating Factors Affecting CO2 Emissions in Malaysian Road Transport Sector. *International Journal of Energy Economics and Policy*.
- Tang Sook Mun (2014). Factors That Influence Green Purchase Behaviour of Malaysian Consumers. *Universiti Tunku Abdul Rahman Faculty of Accountancy and Management*.