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IMPACT OF ENERGY CONSUMPTION AND GHG EMISSION BY PRIVATE VEHICLES IN DHAKA, THE CAPITAL OF BANGLADESH

B.Sc. Engineering (Mechanical) Thesis

Authored by

MUHAMMAD MAHMOOD HASAN
Student ID: 151430

MD. EHSANUL HAQUE
Student ID:151439

MOHAMMAD TOSIF NUR ZAHIN
Student ID:151442

SUPERVISED BY

DR. MOHAMMAD AHSAN HABIB
Associate Professor,
Department of Mechanical and Production Engineering
Islamic University of Technology (IUT)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING (MPE)
Islamic University of Technology (IUT)

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CERTIFICATE OF RESEARCH

The thesis title **"IMPACT OF ENERGY CONSUMPTION AND GHG EMISSION BY PRIVATE VEHICLES IN DHAKA, THE CAPITAL OF BANGLDESH"** submitted by **MUHAMMAD MAHMOOD HASAN (151430), MD. EHSANUL HAQUE (151439)** and **MOHAMMAD TOSIF NUR ZAHIN (151442)** has been accepted as satisfactory in partial fulfillment of the requirement for the Degree of Bachelor of Science in Mechanical Engineering on November 2019.

Supervisor

_____

DR. MOHAMMAD AHSAN HABIB

Associate Professor

Department of Mechanical and Production Engineering

Islamic University of Technology

Candidate's Declaration

It is hereby declared that, their thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma.

Signature of the Candidates'

_____

MUHAMMAD MAHMOOD HASAN

Student ID: 151430

_____

MD. EHSANUL HAQUE

Student ID:151439

_____

MOHAMMAD TOSIF NUR ZAHIN

Student ID:151442

Department of Mechanical and Production Engineering
Islamic University of Technology (IUT)
Board Bazar, Gazipur
Dhaka, Bangladesh

Signature of the Supervisor

_____

DR. MOHAMMAD AHSAN HABIB

Associate Professor

Department of Mechanical and Production Engineering

Islamic University of Technology

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Abstract

The last decade has been a fruitful time interval for Bangladesh to attain economic development which upgraded the economic status of this country to a developing or emerging one. The escalating and envious growth of GDP of this country from Indian sub-continent is more prominent among the economic development and increasing standard of living of the richer portion of the population. This indicates the preference of using private vehicles for daily commuting in the capital city, Dhaka which accommodates most of the important government offices, business centers, reputed educational institutions and hospitals. Private vehicles definitely make life easier but its emission from the engine has got alarming impacts on the environment and its inhabitants. Dhaka is one of the cities which rank worst in the air quality index. This leads to a necessity to investigate the contribution of automobile exhausts to the overall air pollution of Dhaka city. In this study, a survey was conducted on the private vehicles that are in operation within Dhaka city to obtain some information that would lead to analyzing the fuel consumption of different types of private vehicles, their energy requirement, and carbon dioxide emission. The survey conducted in different corners of Dhaka city and through online platforms provided the essential data that was helpful to analyze the condition from different perspectives. Comparative analysis of fuel economy, average annual fuel consumption, average annual energy requirement, and average annual carbon dioxide emission of different vehicles was done in terms of their car model and manufacturing is done with a sample size which assures 95% confidence level for the total population size. In comparison to the capacity of the roads of Dhaka, the total number of vehicles that travel along the roads every day is huge which results in intolerable traffic jams almost every single working day of the week. Traffic jam has got adverse effect on fuel consumption and the waste of energy and excess amount of carbon dioxide emission due to its presence needs to be identified for corrective decision making. In this study, the traffic jam factor which results in additional losses and emissions have been measured for vehicles of different manufacturers and manufacturing year. The overall fuel and energy requirement and carbon dioxide emissions annually by the total number of private vehicles have been calculated on the basis of the survey.

Key Words: Carbon dioxide emission, fuel economy, private vehicles, energy requirement.

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List of Symbols and Abbreviations

M_c	Current mileage of the vehicle
M_i	Initial mileage or mileage while registration of the vehicle
$M_{per\ year}$	The average mileage of the vehicle per year
Y_p	Present year (2019)
Y_r	Year of registration
Y_c	Year of CNG conversion
D_g	Distance traveled using gasoline per day
D_{CNG}	Distance traveled using gasoline per day
D_T	Total distance traveled in a single day
$FC_{av,g}$	Average fuel (gasoline) consumption per year
FC_{av_1}	Average fuel (gasoline) consumption before CNG conversion per year
FC_{av_2}	Average fuel (gasoline) consumption after CNG conversion per year
$FC_{av,CNG}$	Average fuel (CNG) consumption per year
$FC_{rate,g}$	Average fuel (gasoline) consumption rate of the vehicle (km/L)
$FC_{rate,CNG}$	Average fuel (gasoline) consumption rate of the vehicle (km/m^3)
IC	Internal Combustion
GHG	Green House Gas

Chapter 1 Introduction

1.1 Overview of the Project

The number of vehicles plying the road in Bangladesh is 1,255,402 and almost 95% of other vehicles are engine based. The traffic Dhaka city moves with an average speed of only 6.4 kph and with the current growth rate it may fall to 4.7 kph by 2035[1], which is the walking speed of an average human. Not only it contributes to millions of tons of GHG, but the traffic in Dhaka city alone costs 3.2 million working hours a day[2].

With the rapid growth of population and economy the number of vehicles is ever rising, and it is affecting us economically and environmentally. The situation will deteriorate unless drastic measures are taken to address it. To address the environmental issue, the root of it must be singled out and it is of course mostly because of fuel burning. Almost 65% of vehicles are private vehicles which use either gasoline or gasoline-natural gas combination as their fuel system. There are some trucks, buses and heavy-duty vehicles which also use a diesel-based engine. No matter the fuel system, it directly contributes to the production of carbon dioxide which is a major component of greenhouse gas.

Switching to renewable energy or electric-based vehicles might be the long-term solution, but for the short term, it is advisable to choose the fuel that produces less amount of greenhouse gases. To understand that, a survey of existing vehicles is essential to understand the fuel preferences and the consumption rate of the vehicles during the commuting. The survey was conducted both online and, on the field, to get data from wide range of users of different demographics and places. The survey is mainly about the vehicle mileage, the manufacturing models and registration year, fuel consumption rate, daily running quota, etc. The data collected on the survey is, later on, showed on different graphs and pie charts to give an overview of the collected data and then different parameters are calculated from it such as average fuel consumption, annual average mileage, greenhouse gas emission, average power con-

sumption, etc. The calculated data are also compared fuel wise car model wise manufacturing model wise and then projected on the graphs. The decisions are gleaned from these graphs to provide better visualization of the comments made and the discussions done.

1.2 Problem Statement

With population growth ever on the rise, the number of vehicles is also rising and so is the traffic jam. More traffic jam means more fuel consumption, which means more energy consumption, which translates into more production of greenhouse gases. While the traffic jam prone areas are getting detrimental day by day, if proper steps are not taken to reduce this, the consequences may not be limited to human health but also to architecture and other constructions as well, which may lead to a greater financial crisis. Also, more emission of greenhouse gases results in global warming, which will increase the temperature that will render usage of more air conditioning and refrigeration system, which also uses more power and emits more GHG gases, turning the whole process into a vicious cycle.

So, our main problem is to reduce the fuel consumption so that we can, in turn, reduce the number of greenhouse gases emitted and to do that we need to perform an elaborate comparison of the single fuel system and bi-fuel system and determine which one serves our purpose better.

1.3 Objective of the Project

The study aims to compare energy consumption and production of greenhouse gases between a single fuel (gasoline) and a bi-fuel (gasoline and natural gas) system. The objectives of the study are:

1. To conduct a survey on the conventional car mileage and fuel consumption of different cars
2. To analyze the mileage and fuel consumption of different cars
3. To evaluate the environmental impact of single fuel system cars and bi-fuel system cars based on the car model, manufacturing year and their engine capacity

4. To conduct a performance analysis on different car models manufactured in different years and find out the variation during operation from the year of registration until the present time

1.4 Scopes of the Project

The project focuses on the energy consumption of single fuel system vehicles and bi-fuel system vehicles. This will allow the comparative analysis of the energy consumption and greenhouse gas emission rate between them. The scopes of these project are:

1. Conduct a survey for the full consumption of different fuel-based cars.
2. Result and data collection
3. Analysis and evaluation of the result
4. A comprehensive report of research findings

1.5 Report Outline

The whole report is broken down into 5 chapters. Chapter one discusses the overview and scope of the project and the problem being studied. This chapter gives out an idea of the research field and the importance or significance of it. It also provides a bird's eye view of the entire problem area and the methodology.

Chapter two is the literature review where previous works are analyzed and scoped out to understand the procedure of the research and to know the progress of research in this field. For comparison and initiation, previous works in related fields are modeled after and a proper methodology algorithm is developed to approach the problem. The problems are and limitations are briefly understood and give out a total image of the current scenario of the problem.

Chapter three is the methodology. Here the knowledge of previous work is applied to develop working procedures and mathematical equations are derived to reach a certain result. The survey process and data sorting are also discussed in this are and software analysis is also conducted.

Chapter four is the main novelty of the project where it shows and identifies the problems and shows actual results through various graphs. This gives us the entire picture of the solution and provides ample evidence to reach a verdict.

Chapter five is the discussion part. The result and its significance are widely discussed along with future recommendations and challenges faced during the work. This provides us a scope for any future iterations or developments of this type of work to be conducted for similar fields.

In the end, references and appendices are provided for a clearer view of the results and work progress.

Chapter 2 Literature Review

2.1 Sources of Energy

Energy is a quantity of property that must be transferred to an object to perform work or raise the temperature of that object. The first law of thermodynamics state that, energy can neither be created not destroyed. It can only change forms. This implies that in order to achieve a certain form of energy one must source it and convert it from another form of energy. Energy can be sourced from various resources and based on that it is classified into two types:

1. renewable energy and
2. nonrenewable energy

Renewable energy is collected from the sources which are naturally replenishable such as sunlight, ocean wave, wind, geothermal heat, etc. The renewable energy resources available in a wide range of geographical areas in contrast with other energy sources there are limited to certain regions only. It provides opportunities for greater energy efficiency, diversification of energy resources, energy security, and economic development. As the energy is extracted from natural resources and it is easily replenishable, it has a very low impact on the environment itself, thus, reducing pollution of environmental elements such as air and water. Renewable energy resources mainly play a vital role in replacing conventional fuels in electricity generation, space heating, and transportation.

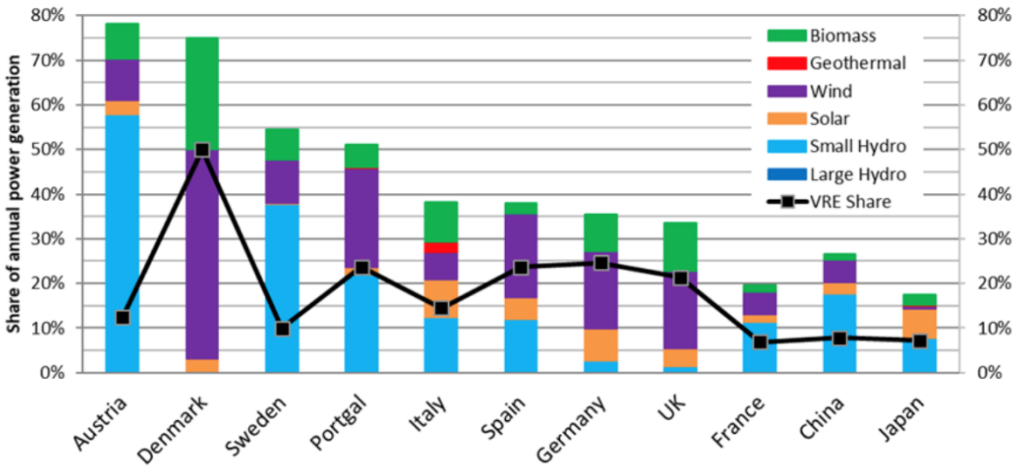

Figure 1. Comparison of the share of renewable energy to the power generation of European countries and China with Japan in 2018[3]

This Figure 1 illustrates the comparison between the power generation and share of the renewable energy of some European countries with China and Japan. Here we can see that European countries like Austria, Denmark, Sweden, and Portugal are leading the group of countries relying on renewable sources for power generation. Renewable energy is derived from natural processes that are replenished constantly such as solar, wind, ocean, hydropower, biomass, geothermal resources, and biofuels and hydrogen.

2.1.1 Solar Energy

Sun is the primary source of renewable energy. The earth receives huge amounts of energy every day from the sun, but the problem has been harnessing this energy so that it is available at the appropriate time and in the appropriate forum. For example, solar energy is received only during the daylight hours, but more heat and electricity for lighting are needed at night. Despite technological advances in photovoltaic cells, solar energy has not become a more significantly more financially competitive source of energy.

Advantages

- It is a perennial, natural source and free
- It is non-polluting
- It does not emit any greenhouse gases.
- Solar energy offers decentralization in most (sunny) locations, meaning self-reliant societies.

- One of the biggest advantages of solar energy is the ability to avoid the politics and price volatility that is increasingly characterizing fossil fuel markets.
- It doesn't result in the destruction of forests and eco-systems that occurs with most fossil fuel operations.

Disadvantages

- Dependent on change in seasons/weather – hence they may not be used always
- Requires high initial investments for productive use
- Solar systems don't work at night directly but the battery bank, which stores energy during day-time can be used during the night.
- Solar electricity storage technology has not reached its potential yet.
- Solar panels are bulky. This is particularly true of the higher-efficiency, traditional silicon crystalline wafer solar modules.
- Technologies for productive use of solar energy

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise. Italy has the largest proportion of solar electricity in the world; in 2015, solar supplied 7.7% of electricity demand in Italy[4]. In 2017, after another year of rapid growth, solar generated approximately 2% of global power, or 460 TWh[5].

2.1.2 Wind Energy

Wind power harnesses the power of the wind to propel the blades of wind turbines. These turbines cause the rotation of magnets, which creates electricity. Wind towers are usually built together on wind farms. There are offshore and onshore wind farms. Global wind power capacity has expanded rapidly to 336 GW in June 2014, and wind energy production was around 4% of total worldwide electricity usage and growing rapidly[6].

Wind power is widely used in Europe, Asia, and the United States. The percentage of wind energy produced by different countries is reaching higher than ever, such as

21% of stationary electricity production in Denmark[7], 18% in Portugal[7], 16% in Spain[7], 14% in Ireland[8], and 9% in Germany in 2010[7][9]. Within 2011, 83 countries around the world resort to wind power on a commercial basis[9].

Many of the world's largest onshore wind farms are situated in the United States, China, and India. Most of the world's largest offshore wind farms are located in Denmark, Germany, and the United Kingdom. The two largest offshore wind farms are currently the 630 MW London Array and Gwynt y Môr.

Advantages

- It is environment-friendly
- It is freely and abundantly available

Disadvantages

- High investment requirement
- Wind speed is not uniform all the time which affects power generated

2.1.3 Biomass and Biofuels

The plants fix solar energy through the process of photosynthesis to produce biomass. This biomass passes through various cycles producing different forms of energy sources. As of 2011, mandates for blending biofuels exist in 31 countries at the national level and in 29 states or provinces[7]. The International Energy Agency has a goal for biofuels to meet more than a quarter of world demand for transportation fuels by 2050 to reduce dependence on petroleum and coal[10]. Biomass is an important source of energy accounting for about one-third of the total fuel used in our country and in about 90% of the rural households. The widespread use of biomass is for household cooking and heating. The types of biomass used are agricultural waste, wood, charcoal or dried dung.

Advantages

- Available locally and to some extent abundantly

- It is a relatively clean fuel when compared to fossil fuels. In a way biomass also cleans our environment by trapping carbon-di-oxide

Disadvantages

- Drudgery involved in collection of fuel
- During indoor cooking and in the absence of sufficient ventilation fuels such as dung cause air pollution which is a serious health hazard
- Unsustainable and inefficient use of biomass often leads to the destruction of vegetation and hence environmental degradation

Biofuels are predominantly produced from biomass feedstocks or as a by-product from the industrial processing of agricultural or food products, or from the recovery and reprocessing of products such as cooking and vegetable oil. Biofuel contains no petroleum, but it can be blended at any level with petroleum fuel to create a biofuel blend. It can be used in conventional healing equipment or diesel engine with no major modification. Biofuel is simple to use, biodegradable, non-toxic and essentially free of Sulphur and aroma.

2.1.4 Geothermal Energy

Geothermal energy is thermal energy generated and stored in the Earth. Thermal energy is the energy that determines the temperature of matter. The geothermal gradient, which is the difference in temperature between the core of the planet and its surface, drives a continuous conduction of thermal energy in the form of heat from the core to the surface. Earth's internal heat is thermal energy generated from radioactive decay and continual heat loss from Earth's formation. Temperatures at the core-mantle boundary may reach over 4000 °C (7,200 °F)[11].

Figure 2 depicts the number one leader in geothermal energy output in the United States, as of November 2016. Next comes the Philippines, which projects a doubling of its energy output by 2030 and expects much of this output to be produced by geothermal means.

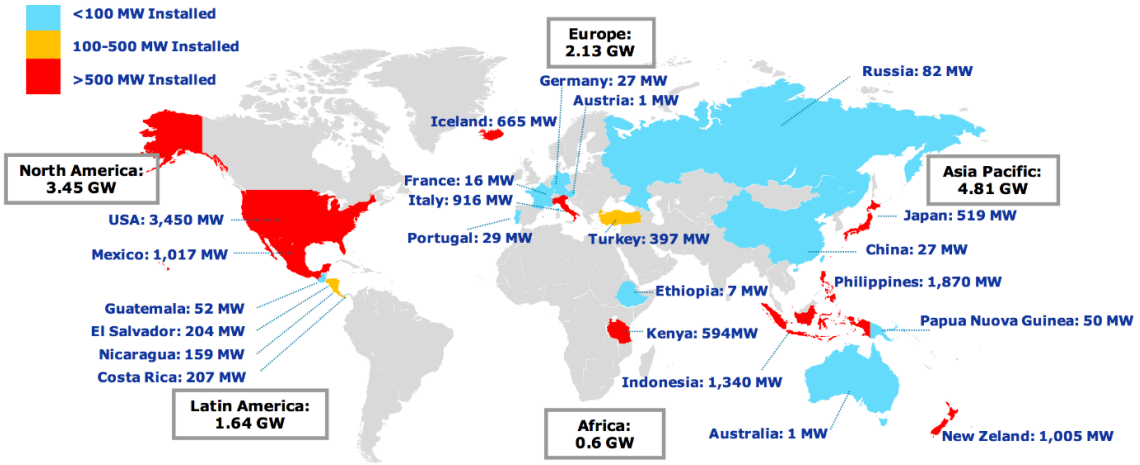

Figure 2: Geothermal energy utilization around the world[12]

2.1.5 Ocean Energy

Oceans cover 70 percent of the earth's surface and represent an enormous amount of energy. Although currently under-utilized, Ocean energy is mostly exploited by just a few technologies: Wave, Tidal, Current Energy and Ocean Thermal Energy.

Tidal Energy

The tidal cycle occurs every 12 hours due to the gravitational force of the moon. The difference in water height from low tide and high tide is potential energy. Similar to traditional hydropower generated from dams, tidal water can be captured in a barrage across an estuary during high tide and forced through a hydro-turbine during low tide. The capital cost for tidal energy power plants is very high due to high civil construction and high-power purchase tariff. To capture sufficient power from the tidal energy potential, the height of high tide must be at least five meters (16 feet) greater than low tide.

Wave Energy

Wave energy is generated by the movement of a device either floating on the surface of the ocean or moored to the ocean floor. Many different techniques for converting wave energy to electric power have been studied. Wave conversion devices that float on the surface have joints hinged together that bend with the waves. This kinetic energy pumps fluid through turbines and creates electric power. Stationary wave energy conversion devices use pressure fluctuations produced in long tubes from the waves swelling up and down. This bobbing motion drives a turbine when critical pressure is reached. Other stationary platforms capture water from waves on their platforms. This water is allowed to runoff through narrow pipes that flow through a typical hydraulic turbine.

Current Energy

Marine current is ocean water moving in one direction. This ocean current is known as the Gulf Stream. Tides also create currents that flow in two directions. Kinetic energy can be captured from the Gulf Stream and other tidal currents with submerged turbines that are very similar in appearance to miniature wind turbines. Similar to wind turbines, the movement of the marine current moves the rotor blades to generate electric power.

Ocean Thermal Energy Conversion (OTEC)

Ocean thermal energy conversion, or OTEC, uses ocean temperature differences from the surface to depths lower than 1,000 meters, to extract energy. A temperature difference of only 20°C can yield usable energy. Research focuses on two types of OTEC technologies to extract thermal energy and convert it to electric power: closed cycle and open cycle. In the closed cycle method, a working fluid, such as ammonia, is pumped through a heat exchanger and vaporized. This vaporized steam runs a turbine. The cold water found at the depths of the ocean condenses the vapor back to a fluid where it returns to the heat exchanger. In the open cycle system, the warm surface water is pressurized in a vacuum chamber and converted to steam to run the turbine.

2.2 Energy Consumption

Energy consumption around the world is significant as mankind is evolving into the modern era of science day by day. In every aspect of our daily life we are consuming a large amount of energy consciously or sub-consciously.

Energy consumption around the world increases by 2.3% in 2018[13], to cope up with the ever-increasing economy. Thus, the greenhouse gas emission has also increased too.

According to the International Energy Agency (IEA) one of the major sectors of energy consumption is producing electricity around the world. Renewable and nuclear energy usage for producing electricity is increasing though still a large amount of electricity is produced from coal and gas. The global electricity demand has increased by 4% in 2018.

Global oil demand has also in robust form as the demand rose by 1.3% due to the petrochemical industries is increasing around the world. The developed countries are the major user of the oil though now the developing countries are also putting their footsteps in a significant way in this ever-demanding sector.

Energy consumption from other sources like coal, gas and renewable energy has also increased around the world. Based on IEA annual report in 2018, there is a 4% increase in renewable energy consumption.

2.3 Energy Consumption of Automotive Industry

From the using and formation of metal for the automotive industry to the final assembly of the automotive parts energy is consumed throughout at a significant amount around the world.

Mainly electricity is needed for various production steps in the automotive industry. Throughout the months of production, the demand changes. Just only in USA over 800 trillion BTU of energy is used early[14].

A study is done on the TOYOTA about their yearly energy analysis by Yang (Eva) Liu et.al[15]. They showed the amount of electricity is needed for different manufacturing steps. There are mainly 6 major steps in the automotive manufacturing process. They are powertrain, stamping, welding, painting, plastics, and assembly.

Throughout the year 2013 according to Yang (Eva) Liu et.al[13]the total energy consumption of Toyota varies around 7,500,000 to 12,000,000 kWh of electricity. Among the processes the painting job requires a major amount of the total energy consumption. According to Galitsky and Worrell[14], 288 MJ/car of electricity is needed only for welding process.

2.4 Energy Consumption of Conventional Vehicles

A life cycle of a conventional car can be distributed into four steps, according to Fysikopoulos et.al[16] they are raw material processing, car manufacturing, car use, and car recovery.

Based on the different fuel used for a conventional car the amount of energy consumption varies. Even for the same car depending on the distance traveled, driving experience and environment the energy consumption varies. Manufacturing companies try to develop their cars day by day to reduce energy consumption.

2.5 Types of Fuels Utilized by Automobiles in Bangladesh

Fuel is one of the chief sources of energy which is mostly acquired from nature and processed properly for utilizing in combustion which in return supplies us with energy. The calorific value of the fuel plays a substantial role to decide the quality of the fuel. Except for this there are some other significant criteria that should be prioritized to fulfill smooth operation of engine. These are:

- High power-to-weight ratio
- Smoothness of operation
- Good drive-ability
- Low noise
- Good fuel economy

- Long-range before refueling
- Good durability
- Low exhaust emissions
- Low maintenance costs
- Low first cost
- Low running costs[17]

Over the years, gasoline has been the prime option as a fuel for passenger vehicles whereas diesel has been dominating as the fuel option for trucks, buses, and other heavy-duty vehicles as the main source of energy. With the passage of time quality of these two fuels improved and at the same time the corresponding engines went through regular modification. This helped to achieve better fuel economy and reducing trend of emission from the combustion. To procure both of them, nature is the ultimate source. These fossil fuel reserves are not scattered all over the world, unlike natural gas. There are certain countries in the world who are rich in petroleum reserve and majority of the countries import them to meet their own demand. So, the internal condition of those countries and international affairs can influence the price of these two fuels. Emissions produced by this two-fossil fuel are more in comparison with other fuels under the same class of origin.

Gasoline or petrol is used as a fuel in Spark Ignited IC Engine which is derived from petroleum crude oil through the fractional distillation process. It is generally a mixture of different hydrocarbon liquids as many as 200 or more in number. The molecules of different hydrocarbons carry carbon atoms of 4 to 11-12 in number. At atmospheric conditions, its boiling point ranges from 38°C to 205°C[18].

Natural gas is a fossil fuel found in nature in a gaseous form quite abundantly spread everywhere in the world unlike other fossil fuels of liquid or solid physical state. The major component that almost unanimously leads in its composition in Methane. It is the lightest among all the hydrocarbons containing a single carbon and four hydrogen atoms. It is lighter than air and shows deliberate tendency to get dispersed in air. CNG stands for Compressed Natural Gas. The already describes that it is natural gas stored under high pressure which is odorless, non-poisonous and non-

corrosive[19]. Natural gas is compressed to the high pressure of 3000 psi in Bangladesh. CNG refueling stations have pipeline transmission system for natural gas. After collecting the natural gas it is compressed to 3000 psi pressure and stored to be sold[20].

Natural gas is gradually capturing a significant share among the sources which are the leading sources of energy in the present world. Currently, it has flourished up to 23.7% of the total share ranking third among all other options.

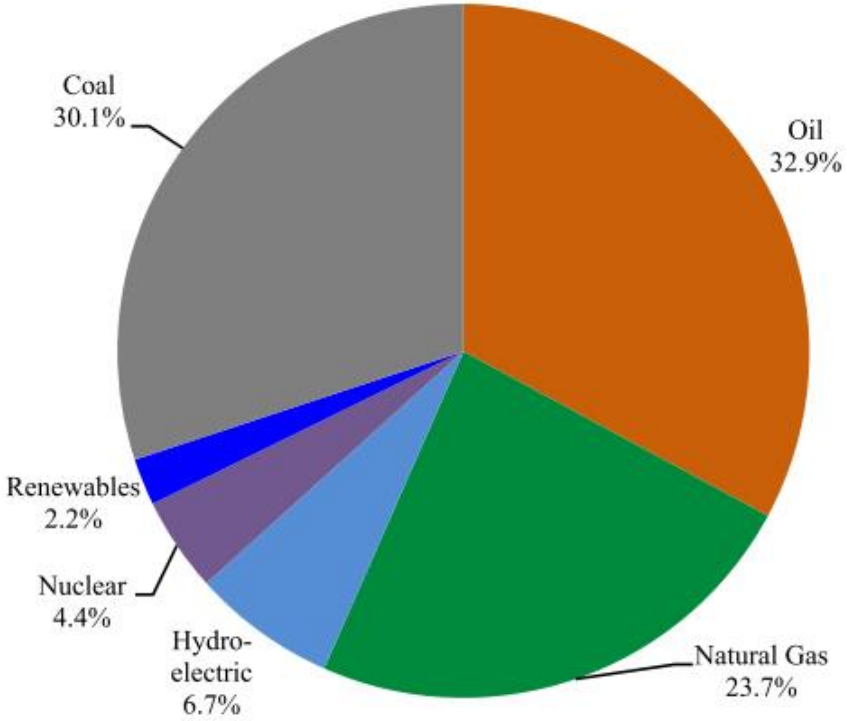

Figure 3 World primary energy consumption[21]

Diesel fuel is almost the same as furnace fuel oil. The only difference is the reduced presence of cracked gas oil than usual as the cetane value of diesel is reduced by high aromatic content of the cracked gas oil[22]. Diesel is directly obtained from the distillation of crude oil as a mixture of different hydrocarbons. Besides, naturally obtained diesel fuel through crude oil which is a kind of fossil fuel, there are synthetic types of diesel that can be produced from carbonaceous material like biomass, natural gas, biogas, coal, etc. Diesel fuel contains 12% more heat energy when compared against the same amount of gasoline[23].

The following table contains different physiochemical properties of Gasoline, CNG and Diesel. This table speaks a lot about each of the fuels from different perspectives. In Bangladesh, private cars use Gasoline and CNG mostly as fuel.

Table 1. Physiochemical Properties of Gasoline, CNG, and Diesel[21]

Properties	Gasoline	CNG	Diesel
Octane/Cetane Number	85-95	120-130	45-55
Molar mass (kg/mol)	109	17.3	204
Stoichiometric $(A/F)_s$ mass	14.7	17.2	14.6
Stoichiometric mixture density (kg/m^3)	1.42	1.25	1.46
Lower heating value (MJ/kg)	43.5	47.5	42.7
The lower heating value of stoichiometric mixture (MJ/kg)	2.85	2.62	2.75
Flammability limit in air (vol% in air)	1.4-7.6	4.3-15.2	1-6
Flame Propagation speed (m/s)	0.5	0.41	-
Adiabatic Flame Temp. (℃)	2150	1890	2054
Auto-ignition Temp. (℃)	258	540	316
Wobbe Index (MJ/m^3)	-	51-58	-

2.6 Comparative Analysis of CO2 emission by combustion of various fuels

The emission of carbon dioxide by different fuels is mainly dependent on the chemical composition of each of the fuels. Carbon dioxide is one of the products of combustion reaction of the individual fuels. As a result, the contents present in the fuels decide what it is going to produce at the end of the reaction. Carbon dioxide production after the reaction of combustion is dependent upon the carbon content present in the reactant fuel. At the same time the energy produced by each of the fuels for participating in combustion process in equal quantity is not same. This is again dependent upon carbon (C) and hydrogen (H) content present in the fuel. If there is moisture and

other elements like Sulphur, Nitrogen and non-combustible materials are present in the fuel, there will be a reduction in the heating value of that particular fuel. For this reason, comparison among different fuels in terms of carbon dioxide emission for any particular amount of energy production can give us some insight about performance of various fuels.

Table 2. CO2 emission per million British thermal units (Btu) of energy by combustion of various fuels[24]

Name of the fuel	CO_2 emission per million British thermal units (Btu) of energy (in Pound)
Coal (anthracite)	228.6
Coal (bituminous)	205.7
Coal (lignite)	215.4
Coal (subbituminous)	214.3
Diesel fuel and heating oil	161.3
Gasoline (without ethanol)	157.2
Propane	139
Natural gas	117

From this table, it is quite easy to understand that among different types of fossil fuels, coals of different kinds emit more carbon dioxide. But none of these are utilized as fuel in automobiles. Among the different types of fuels used by vehicles, Diesel is more prone to carbon dioxide emission which is followed by Gasoline in terms of polluting the air. Natural gas as an automobile fuel does the best performance among all other fossil fuel in terms of carbon dioxide emission as its combustion process emits minimum carbon dioxide compared to others.

2.7 Types of Engines Based on Fuel Usage

Most of the conventional vehicles use an IC engine for locomotion. IC engines are again two types.

- Two Stroke Engine
- Four Stroke Engine

In the case of two-stroke engines the crankshaft revolves only once for one power stroke. Whereas, for four-stroke engines, the crankshaft revolves twice for one power stroke. Two-stroke engines produce more harmful emissions compared to four-stroke engines and for that reason the usage of vehicles running on two-stroke engines is restricted in Bangladesh considering the environmental issues.

In the two-stroke engine the first stroke is known as compression in which the charge within the cylinder is compressed by the piston moving upward. The compressed charge is ignited before the piston reaches the top dead center. At this position, fresh charge is inserted below the piston within the crankcase. In the second stroke namely power stroke, the ignition of air-fuel mixture will produce high pressure and high-temperature condition above the piston within the cylinder which will force the piston downward with a huge force. The fresh charge already existing within the crankcase now gets compressed as the piston moves down. At one stage of the piston moving down, the exhaust port gets uncovered and the exhaust gets released from the cylinder. The piston keeps on moving down and when it reaches close to the bottom dead center, the transport port opens up and partially compressed charge from the crankcase enters the cylinder of the engine. The fresh charge entering the cylinder drives out rest of the exhaust flue gas remaining within the cylinder even after the exhaust port is opened. In this way the cycle repeats.

In a four-stroke engine, the first stroke is named as intake stroke. In this stroke, the inlet valve of the cylinder remains open and the exhaust valve remains closed. The piston moves downward and creates a negative pressure within the cylinder that draws the air-fuel mixture in a gasoline-powered engine and only air in case of a diesel-powered engine. The next stroke is compression in which both the valves remain closed and piston compresses the charge moving upward. After compression, the power stroke is executed which is the only stroke in the cycle that produces the power required to run all the four strokes. The piston moves downward and when it is close to the bottom dead center, the exhaust valve opens up to expel the exhaust flue gas which is the product of combustion. The last stroke is named as exhaust stroke. The inlet valve remains closed and the piston moving up drives the exhaust flue gas out of the cylinder through the exhaust valve. The cycle repeats itself in this way.

Spark ignition engines work in Otto cycle which is an ideal cycle for four-stroke engines running on gasoline. Otto cycle has got four different processes among which two are adiabatic and the rest of the two are constant volume processes. Compression and expansion are adiabatic in nature and on the other hand heat addition and heat rejection processes are isochoric or constant volume in nature. However, the actual Otto cycle is not identical to the ideal one. The reason behind this is concerned with different profiles in the compression and expansion curves. The reasons behind such differences are as follows:

- Heat losses
- Non-instantaneous combustion
- Exhaust valve opening time

The diesel cycle is another combustion technique used in IC engines for power generation. Here the fuel is ignited by the heat produced by the compression of air to a very high extent. This is why the compression ratio has to be maintained higher than the engines running on Otto cycle. In the engines running on the principle of Diesel engine, fuel is sprayed over the compressed air at the beginning of power cycle. Therefore, in place of a spark plug there exist a fuel injector for Diesel engine. The compression and expansion processes of Diesel cycle are adiabatic in nature. The heat addition process is isobaric or constant pressure process whereas the heat rejection process is isochoric in nature.

In the present time, natural gas is quite a popular form of fuel in automotive vehicle usage for its advantage of producing less amount of emissions and cheaper price range. When a gasoline engine is converted into a natural gas one, the engine performance reduces by 10-12% due to the smaller chare of fuel for the stoichiometric combustion of natural gas[19].The following basic components are required for any design of CNG engine-vehicles.

Basic components:

- Filler valve
- Pressure tank & multi-valve
- Connecting high-pressure pipe

- Pressure gauge (optional)
- Gas pressure regulator

Vehicles with direct gas injection feature:

- Electronic injectors
- Injection rail

A vehicle with a central gas mixing feature:

- Stepper
- Mixer

Electronic control unit

- Natural gas/gasoline switch and fuel gauge xii.
- Catalytic converter and lambda sensor

Concerning on road transport, the research of natural gas engine vehicles are focusing on,

- Passenger cars and light-duty vehicles (PC's/LDV's)
- Heavy-duty vehicles and buses (HDV's/buses).

There are three different types of natural gas-powered vehicles in terms of fuel supply. These are:

a) Dedicated CNG engine
b) Bi-fuel retrofitted gasoline engine
c) Dual-fuel diesel engine[21]

2.7.1 Dedicated CNG engine:

Dedicated CNG engines use natural gas as its only fuel with spark-ignition arrangements. Natural gas has got higher octane number in comparison with other fuels. To utilize this advantage over other fuels, these engines are optimized well[21]. As natural gas contains lighter molecules of hydrocarbons, the emission effects from combustion of this fuel are relatively lower.

2.7.2 Bi-fuel retrofitted gasoline engine:

Vehicles having a bi-fuel engine can generate power with either gasoline or natural gas. The driver has got liberty to choose any of the fuel options during

journey by that vehicle. There is a switch in the dashboard of the car by which they can choose the fuel he/she wants to burn. The engine used for this bi-fuel operation is a spark ignited IC engine. The vehicles running only on gasoline can be easily converted into a bi-fuel one. In the context of Bangladesh also, a lot of gasoline-based vehicles have been converted into bi-fuel engine-based ones. The combustion properties of natural gas are not similar to that of other fuels like gasoline and diesel. The ignition delay time is one of them. Natural gas has longer delay time due to low flame propagation speed. As a result, when an engine which is fueled conventionally with gasoline is operated with natural gas, combustion duration becomes comparatively longer. To optimize this effect, advanced spark timing operation has no alternative. For this reason, retrofitting is compulsory for converting a conventional gasoline engine to a bi-fuel one[21]. In this type of engine only one fuel type can be used at a time even though we can store two different fuels to burn to generate power.

2.7.3 Dual-fuel diesel engine:

These are also a kind of IC engine. They use either on diesel only or a mixture of diesel and natural gas. In the case of bi-fuel engine there was no scope of mixing two different fuels to be utilized at a time. These kinds of engines are normally not seen in our country.

2.8 Energy Consumption and Performance of Hybrid Vehicles

The hybrid vehicle is one of the latest additions to the automotive industry that provides better fuel economy and reduced harmful emissions. These vehicles rely on two sources to propel themselves. Like other conventional vehicles, it has got an IC engine and electric motor backed by a high voltage battery pack. When the vehicle is running on IC engine, the alternator employed to convert some power from the engine to alternating current produces electricity that charges the battery. This energy stored within the battery can later be utilized to propel the vehicle without having the IC engine operating. As a result, a handsome share of energy can be saved while expelling lesser amount of greenhouse gas emissions.

In the history of the automobile, hybrid vehicle was first displayed at the Paris Salon of 1899[25]. It had an air-cooled gasoline engine backed by a lead-acid battery-powered electric motor. When the vehicle was in motion or in standby position, the battery used to charge itself taking power from the engine. Later when the vehicle power demand was more than the power generated by IC engine, the electric motor backed by battery used to take the additional load to propel the vehicle.

Plug-in Hybrid Electric Vehicle (PHEV) is a kind of hybrid electric vehicle whose battery can be charged not only by the IC engine in operation like the conventional hybrid vehicles but also by any external power source. This allows the vehicle to rely more on an electric motor than the IC engine which is more prone to causing air pollution through its emission. Plug-in hybrid electric vehicles are considered to be a subset of hybrid vehicles which according to the IEEE have at least the following:

- a battery system of 4 kWh or more used to power motion
- a means of recharging from an external electrical source
- an ability to drive 10 miles without using fuel[26]

But it would not be a wise decision to choose a plug-in hybrid vehicle over any conventional vehicle or general hybrid ones because the environmental issues and economic concerns related to the production of electricity which will be utilized to charge the batteries of such vehicles play a vital role. Whether the power demand of a certain country is satisfied by the existing power generation capacity has to be determined in this case. At the same time, how efficient the existing power plants are and the cost of power production will regulate the usage of such vehicle in a country.

2.9 Composition of Exhausts from Different Engine Type

When any petroleum-based fuel undergoes complete combustion within an IC engine then its products are supposed to contain carbon dioxide (13%) and water (13%), with nitrogen from air comprising most (73%) of the remaining exhaust[27]. A very small portion of the nitrogen is converted to nitrogen oxides and some nitrated hydrocarbons. Depending on engine's operating condition, there can be some amount of excess oxygen. If the combustion of fuel remains incomplete within IC engine, then

there will be emission of carbon monoxide, unburnt fuel, lubricating oil and oxidation, and nitration products of the fuel and lubricating oil.

Diesel engines produce two to ten times more particulate emissions than gasoline engines without catalytic converter of comparable power output and two to forty times more particulate emissions than gasoline engines equipped with a catalytic converter[27]. Researches done so far indicates that emissions from spark-ignition engines using gasoline are qualitatively similar to the emissions from diesel engines[28].

Fuel evaporation may occur from fuel lines and carburetors. Since emissions from exhaust pipes have been reduced due to gradual advancement, fuel evaporation has become relatively more important as a source of hydrocarbons. In the passenger vehicles running on gasoline with catalytic converters, 30-60% of the hydrocarbon emissions are caused by fuel evaporation. In the case of diesel fuel the vapor pressure under ambient condition is quite low, as a result the emission through fuel evaporation is not significant[29].

Table 3. Constituents of IC Engine Exhaust Gases[30]

Major Constituents (greater than 1%)	Minor Constituents (less than 1%)
Water, H_2O	Oxides of sulfur, SO_2, SO_3
Carbon dioxide, CO_2	Oxides of nitrogen, NO, NO_2
Nitrogen, N_2	Aldehydes, HCHO, etc.
Oxygen, O_2	Organic acids, HCOOH, etc.
Carbon monoxide, CO[(a)]	Alcohols, CH, OH, etc.
Hydrogen, H_2[(a)]	Hydrocarbons C_nH_m
	Carbon monoxide, CO[(b)]
	Hydrogen, H_2[(b)]
	Smoke

(a) Spark-ignition engine
(b) Diesel engine

2.10 Current Vehicle Status of Bangladesh

Table 4: Number of Registered Vehicles in Dhaka (year wise)[31]

Type of Vehicles	Up to-2010	2011	2012	2013	2014	2015	2016	2017	2018	Up to Sep/2019	Grand Total	% of Vehicles
Ambulance	1374	137	114	190	254	358	287	400	456	349	**3919**	0.26%
Auto Rickshaw	7664	112	111	60	56	428	582	42	5637	6742	**21434**	1.44%
Auto Tempo	1662	1	1	0	0	0	0	0	0	0	**1664**	0.11%
Bus	16783	1501	1218	971	1364	2221	3479	3294	2322	2215	**35368**	2.37%
Cargo Van	3231	477	278	676	603	398	1001	1285	1224	3	**9176**	0.61%
Covered Van	4277	1910	1170	1850	2352	1855	2613	4030	4381	1947	**26385**	1.77%
Delivery Van	11990	839	577	709	901	1464	1898	2199	1882	1005	**23464**	1.57%
Human Hauler	2718	569	145	115	109	502	787	217	211	0	**5373**	0.36%
Jeep(Hard/Soft)	19520	1698	1241	1107	1582	3109	4217	4712	4864	3717	**45767**	3.06%
Microbus	46202	3540	2643	2227	3842	4569	5169	4927	3585	2426	**79130**	5.30%
Minibus	9490	136	103	83	135	103	164	159	185	127	**10685**	0.72%
Motor Cycle	210081	34708	32810	26331	32894	46764	53738	75251	104064	76104	**692745**	46.39%
Pick Up (Double/Single Cabin)	20481	7258	5149	4908	7295	7916	8482	10300	9615	6836	**88240**	5.91%
Private Passen-ger Car	163004	11423	8187	9231	12972	18422	18010	19573	16319	11279	288420	19.32%
Special Pur-pose Vehicle	759	60	28	78	50	66	224	233	502	289	**2289**	0.15%
Tanker	817	152	90	136	163	146	209	188	326	187	**2414**	0.16%
Taxicab	36011	52	43	4	302	54	30	4	94	7	36601	2.45%
Tractor	9923	4169	2841	1634	1443	1637	2510	2754	3359	1978	**32248**	2.16%
Truck	26922	4205	2824	3522	5767	4424	4553	7035	8731	5110	**73093**	4.89%
Others	168	0	0	660	967	1307	2567	3145	3592	2412	**14818**	0.99%
TOTAL	**593077**	**72947**	**59573**	**54492**	**73051**	**95743**	**110520**	**139748**	**171349**	**122733**	**1493233**	0.26%

This report from Bangladesh Road Transport Authority (BRTA) contains information about registered vehicles until September of 2019 in Dhaka city[31]. In Bangladesh, up until 2019 about 15 million vehicles are registered in Bangladesh. Among them, only about three hundred thousand are private vehicles. There are a lot of other vehicles that also run on engine as well. With the exception of Microbus, minibus, and SUVs, most of them run on single fuel system, mostly diesel or electric. The number of microbus, minibus, and SUV's a lower comparative to private passenger cars. Only these vehicles have the option to convert to CNG or dual fuel system. Among them, private cars and microbus are very popular for dual fuel systems. Other heavy vehicles, such as Jeep, boss, truck, cargo van, tanker, tractor, truck, etc. mostly

run on diesel. While, auto-rickshaw, auto tempo, etc. Mostly run on electricity. The ambulance is mostly considered under the microbus and taxi cabs are considered similar to private passenger cars. In our study we have considered a sample size of 386 which can represent the data of 1,000,000 vehicles. This is why, combining the numbers of private passenger cars, taxi cabs and some heavy vehicles that can be converted to the dual-fuel system are considered as our working sample which is not more than 500,000. As our study mainly revolves around a competitive analysis of two fuel systems, mainly gasoline and CNG, we have excluded the vehicles that run on diesel or electricity. We have also excluded vehicles with 2 wheels and 3 wheels.

2.11 Adverse Effects of Automotive Engine Exhausts

Like any other pollutions, air pollution has got serious consequences on the environment and all the living creatures dependent on it including human beings. Air pollution is severe in places which are crowded by huge population or full of industries not taking enough measures to keep the pollution within limit. In urban regions, most of the air pollution is caused by vehicle emissions. The far-reaching consequences of air pollution by vehicle emissions require detailed discussion.

2.11.1 Adverse Effects on the Environment

Car pollution mainly contains exhaust from cars, engine spills, and noises. Exhaust from cars contains several types of gases and solid matters. These gases are mostly hydrocarbon burns along with oxides of sulfur and nitrogen, which are acidic in nature. The carbon dioxide burns contribute to global warming. Diesel or gasoline burns cause 0.6° Celsius or 1° Fahrenheit rise in global temperature[32]. The rise in temperature results in destroying natural habitats of many wildlife and sea life. The oxides of nitrogen and sulfur make this with rainwater and cause acid rain that hampers the agriculture farm and landscapes. The nitrous oxide also damages the ozone layer which blocks the UV light. The acid rain and UV light damage soil properties, crops, and forests. Also, oil spills and other harmful material from the car exhaust mix with waters from different sources such as rivers and contaminates the water which also causes an adverse effect on the ecosystem. The following Figure 4 illustrates how the car-

bon emission has increased over the centuries due to usage of different fossil fuels available.

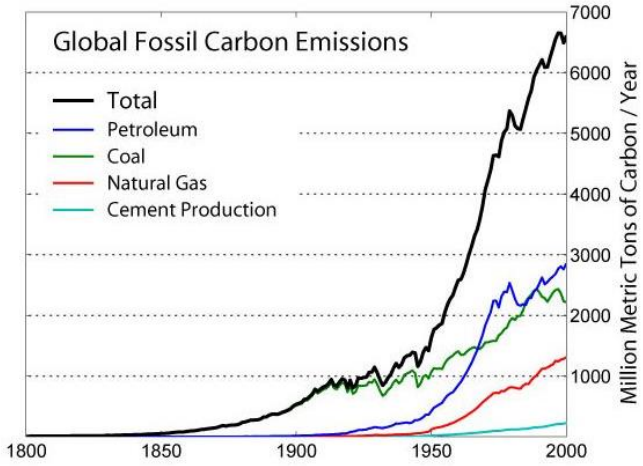

Figure 4: Global Fossil Carbon Emissions[33]

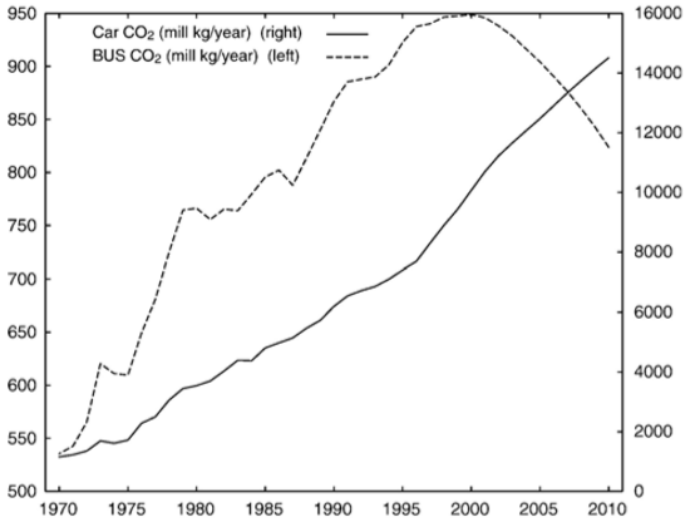

Figure 5: Estimated CO2 emissions from cars and buses[34]

Figure 5 shows the gradual increase in carbon dioxide emission by cars and buses from the year 1970 to 2010.

Production of vehicles also causes an adverse effect because the vehicles require steel, leather, aluminum, plastics etc. which also need to be produced that has also environ-mental consequences. After the car lifecycle has ended, the junk metals, bat-

tery acid spills, plastics etc. Causes hamper to the soil and waters nearby. Fortunately, 80 to 90% of the car pollution comes from the fuel exhaust and most of the car junks are nowadays recycled and reused. Nevertheless, they have an environmental footprint which does have an adverse effect.

Table 5. Automobile Parts and Pollution Problems Associated with them[35]

Parts of Vehicle	**Problems and Pollution**
Battery	It contains lead and HCl.
Bumper	Wastes include cyanide, chromium and other heavy metals.
Brake shoes	Contains asbestos.
Engine	Waste per ton of castings, 0.3 ton mainly slags with some toxic contaminants.
Exhaust	Contains several air pollutants, 20% NO2, 23% Hydrocarbons and 45% CO.
Seat Textiles	Wastes include dyes, acids, solvents, greases, and waxes.
Gasoline Tank	Serves as a source of benzene and hydrocarbons emissions during fueling.
Plastic Components	Toxic chemicals used in the production include vinyl chloride, formaldehyde, phenols, and several solvents.
Tires	Toxic chemicals used in the production include amines, thiurams, nitrosamines, and solvents.

Production of petroleum is also a concern for environmental pollution. After crude oil is extracted, it needs to be purified which results in a lot of byproducts that are highly unusual and undesired. The area in which a petroleum industry is active, damages the ecosystem of that environment. With civilization being on the rise and a lot of power source being invented from petroleum, the production is on the rise. Shipping petroleum also is a great concern because it raises the chances of oil spills in the sea and that causes heavy damage to marine life.

2.11.2 Adverse Effects on Mankind

Particulate matter, hydrocarbons, carbon monoxide, and other car pollutants are pernicious towards human health. Most Vehicles emit high levels of particulate matter, which is mostly airborne. These can result in skin and eye irritation and allergies, and lungs problem, which lead to respiratory problems. The nitrogen and sulfur oxides react with hydrocarbons which affect the ozone layer, which may be beneficial in blocking the UV light, but ozone inflames lungs, causing chest pains and coughing and making it difficult to breathe. Carbon monoxide, another exhaust gas, is particularly dangerous to infants and people suffering from heart disease because it interferes with the blood's ability to transport oxygen. Other car pollutants that harm human health include sulfur dioxide, benzene, and formaldehyde. Noise from cars is also harmful, damaging hearing and causing psychological ill-health.

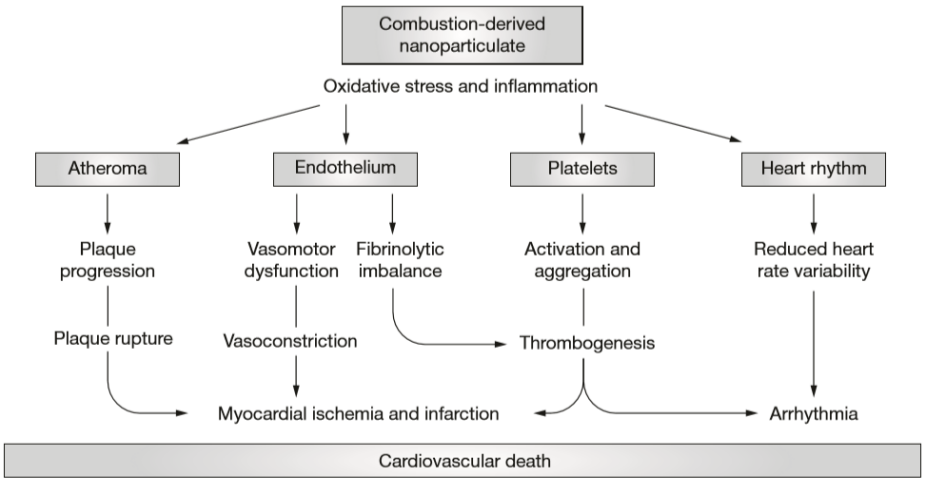

Figure 6: The mechanisms through which combustion-derived nanoparticulate matter causes acute and chronic cardiovascular disease[36]

This Figure 6 shows the mechanism through which the Nano-particulate matter derived from the combustion causes acute and chronic cardiovascular disease.

Table 6 Various pollutants and their effect on human health and on the natural environment[35]

Pollutants	Effects on Human Health	Effects on the Natural Environment
Carbon monoxide	It can affect the cardiovascular system, exacerbating cardiovascular disease symptoms, particularly angina; may also particularly affect fetuses, sickle cell anemic and young children. It can affect the central nervous system, impairing physical coordination, vision and judgment, creating nausea and headaches, reducing worker productivity and increasing personal discomfort.	
Nitrogen oxides (NOX)	Nitrogen dioxide (NO2) can affect the respiratory system. Nitrogen monoxide (NO) and nitrogen dioxide (NO2), where they play a part in photochemical some formation, may contribute indirectly to increased susceptibility to infections, pulmonary disease, impairment of lung function and eye, nose and thread irritations.	NO and NO2 can contribute significantly to acid deposition damaging aquatic ecosystems and other ecosystems such as forests NOx can also have a fertilizing effect on forests.
Sulfur oxides (SO2)	Sulfur dioxide (SO2) can affect lung function.	Sulfur oxides can contribute significantly to acid deposition impairing aquatic and forest ecosystems. Sulfates can affect the perception of the environment by reducing visibility even at low concentrations.
Particulate matter (SPM and RPM)	Fine particulate matter may be toxic in itself or may carry toxic (including carcinogenic) trace substances and can alter the immune system. Fine particulate can penetrate deeply into the respiratory system irritating lung tissue and causing long-term disorders.	Fine particulate can significantly reduce visibility. High dust and soot levels are associated with a general perception of the dirtiness of the environment.
Lead	It can cause brain damage, encephalopathy in children resulting in lower IQ, death, hyperactivity and reduced ability to conceive.	Lead

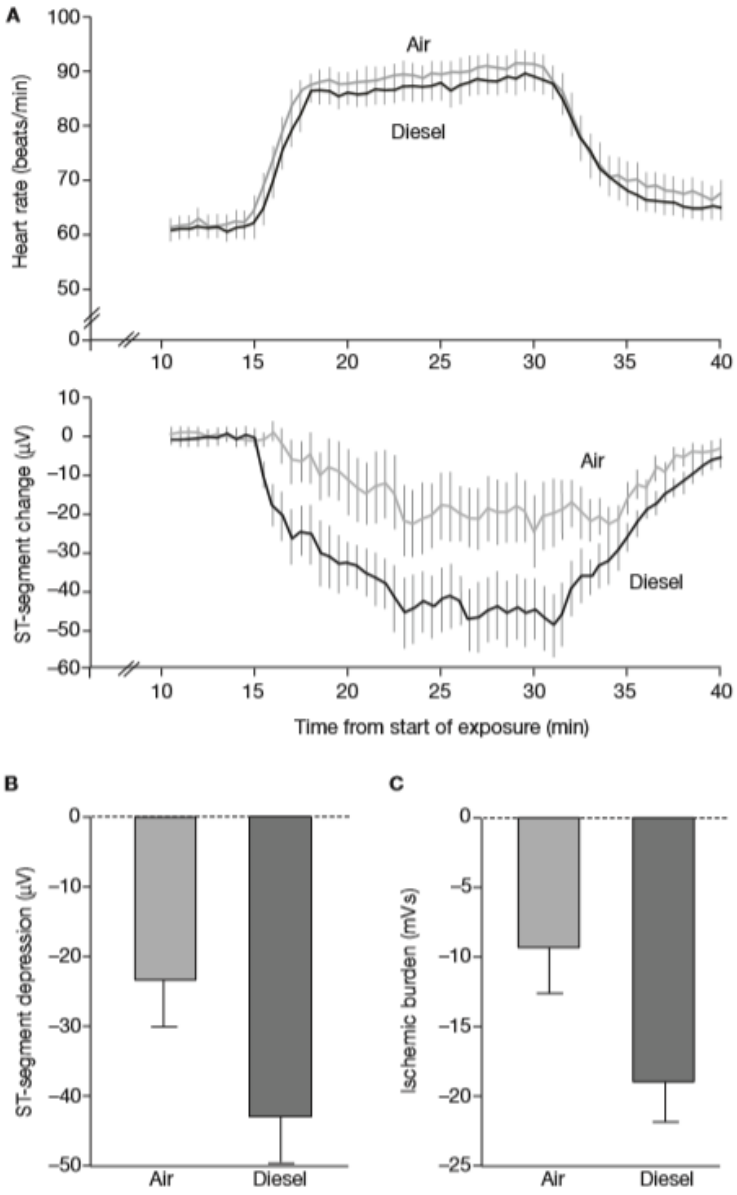

Figure 7. (A) Average change in heart rate and ST-segment in lead II. (B) Maximal ST-segment depression (P = 0.003, diesel exhaust versus filtered air), and (C) total ischemic burden (P <0.001, diesel exhaust versus filtered air) as an average of leads II, V2, a[37]

This Figure 7 explains the clinical consequences of diesel exhaust inhalation in patients with coronary heart disease. Electrocardiographic ST-segment depression occurs during exercise in patients with coronary heart disease exposed to filtered air (solid line) or dilutes diesel exhaust (dashed line).

2.11.3 Adverse Effects on Architecture

In the urban area, the major contributor to air pollution is considered to be the exhaust released by the vehicles moving in different streets. If there is almost negligible quantity of industries producing harmful wastages that may lead to air pollution, exhaust from the vehicles can be considered to be the prime source of air quality degradation. The condition of Dhaka city is quite coinciding with this scenario. By far it is crystal clear to apprehend the damage air pollution can do to our environment and its inhabitant. The demerits of air pollution are not confined to these. It is considered to be one of the key factors behind downgrading of our architecture.

Most of the vehicles depend on fuels that are processed from fossil fuels. As a result, the exhaust from the combustion of these fuels is often rich in Sulphur dioxide, Nitrogen dioxide, Carbon dioxide with other harmful pollutants. Although modern vehicles include catalytic converters to nullify the harmful effects of these gases, the resultant of these cannot really contribute enough to reduce air pollution to an acceptable level.

The harmful pollutants from the vehicle's exhaust contribute to the occurrence of acid rain. The condition gets severe when the concentration of Sulphur dioxide is more. With the progress of industrialization, the downgrading of buildings is more noticeable now. The prime culprit behind this thing is the occurrence of acid rain on a regular basis due to presence of higher concentration of pollutant gases in the atmosphere. The man-made reasons behind acid rain are significant by manifold in comparison to the natural causes. Air pollution downgrades architecture in five different ways. These are abrasion, deposition, and removal, corrosion, direct and indirect chemical attack[38]. Although the damages like discoloration and structural failure caused by air pollution are insignificant and require minimum expense to recover, corrosion effects by acidic deposition may turn out to be very significant and expensive to restore to former conditions [38].

Damages done by acid deposition are even more alarming and significant in case of ancient structures of historical significance as most of them are built with limestone

and calcareous stones. Both of these materials are prone to corrosion[38]. Brimblecombeet al. carried out research on potential damage to modern building materials like aluminum, zinc, copper, plastic, paint, and rubber in London and Prague[39]. Their observation depicts that improvement in air quality can reduce the damage done to those building materials.

Chapter 3 Methodology

3.1 Research Progress

The research initiates with analyzing the problem statement regarding conventional vehicles of Bangladesh. To fulfill the objectives of the research, extensive studies have been conducted in various journals, thesis, books, websites, etc.

A survey is constructed to extract data regarding the full consumption and GHG emissions from conventional vehicles of Bangladesh. The study aims to understand the relationship of engine capacity, manufacturing year, registration year, total mileage, initial mileage (at the time of registration), daily run, fuel preferences, fuel consumption rate, annual fuel consumption, etc.

The survey is done on 2 fronts, initially, it is done on online platforms. But due to several circumstances, the data collected on the online platform was not sufficient. Then along with online platforms, field data has been collected physically, by interviewing drivers and owners of the vehicles.

Once the data has been collected, the data has been revised to ensure that all the daters are valid and feasible. If any data are found that contradicts normal parameters, the data has been considered as invalid and thus, disregarded as sample size. The reasons due to which, data that have been considered invalid are as follows,

- The average daily run doesn't add up with net mileage.
- Fuel consumption rate too high or too low.
- Vehicle manufacturing year doesn't complement the initial mileage of registration year.
- Vehicles with unusual data and parameters

Once the data has been properly sifted through and validated, various calculations have been done according to the equations derived. The data, both calculated and collected our featured in graphs and different full systems are compared based on the

parameters mentioned above. All of this data and calculations are elaborately discussed in the research report.

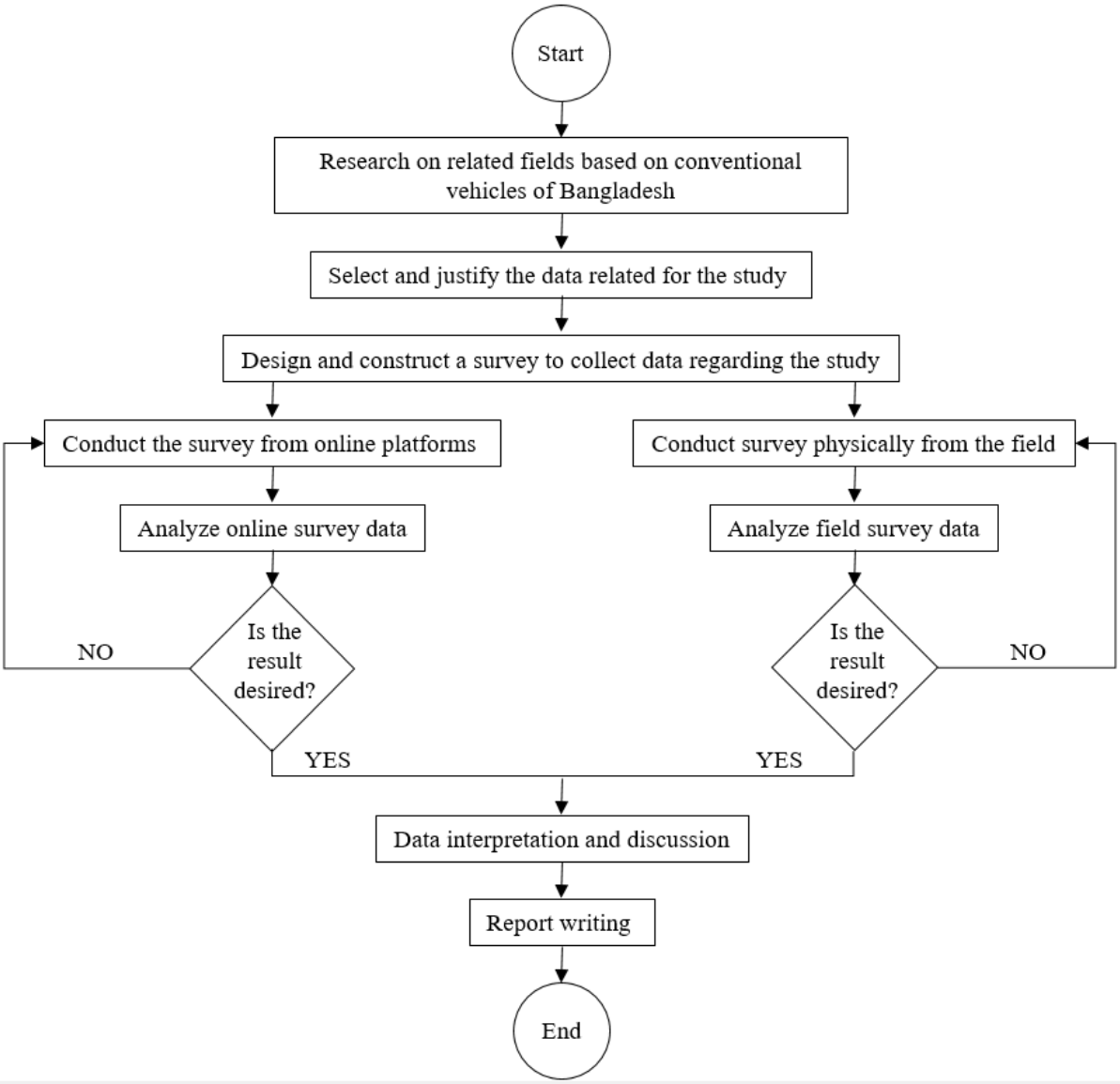

Figure 8: Flow chart of thesis progress

3.2 Sampling Size

The number of observations taken under consideration for any statistical analysis or research is referred to as sample size. This number is the representative of whole population that is taken under research condition. For qualitative research, sample size plays an important role. The sample size depends on various considerations of the population criteria. To determine the perfect sample size for any population there are many prominent methods. Among them in our research we have followed the common procedure from formula and sample size table of Krejcie and Morgan[40].

Bangladesh has a huge range of vehicles around the country. Among them, from the published data from Bangladesh Road Transport Authority (BRTA) the number of private passenger cars is 288420 up to September 2019.

To determine proper sample size for this number of vehicles in Bangladesh, we are considering 95% confidence level. To include the true population parameter the percentage of all samples that can be expected to provide that result is called confidence level. Our 95% confidence level refers that the taken sample size will indicate the true parameter of the population at 95% confidence interval.

This confidence level increases with the number of the sample size. But for a 99% confidence level which is wider than 95%, will be more accurate. In order to reach that level of accuracy, the sample size will be so big. In real life scenario of Bangladesh, to collect that amount of data is quite challenging. That's why we chose 95% confidence interval that will be closer enough to the accurate result.

To calculate the sample size this following equation is used[40]

$$s = X^2 * N * P * (1 - P) \div d^2 * (N - 1) + X^2 * P * (1 - P)$$

Here,

$s =$ Required sample size

$X^2 =$ The table value at the desired confidence level of chi-squire for 1 degree of freedom (3.841 for 95% confidence level at 1 degree of freedom)

$N =$ Population size

$P =$ The population proportion (0.50 for maximum sample size)

$d =$ The degree of accuracy as a proportion (0.05)

So, the sample size,

$$s = X^2 * N * P * (1 - P) \div d^2 * (N - 1) + X^2 * P * (1 - P)$$

$$= 3.841 * 288420 * 0.50 * (1 - 0.50) \div 0.05^2 * (288420 - 1) + 3.841 * 0.50 * (1 - 0.50)$$

$$= 383.02$$

From the population table of Krejcie and Morgan, the sample size is identified as 384 for a population of 1,000,000 and the sample size 382 for a population of 75,000. As our population size is 288,420 which is in the range between 1,000,000 and 75,000. The sample size for this study is considered 384 which coincides with calculated data.

The table is shown on the following page.

Table 7:Table for Determining Sample Size for Different Population Size[40]

Population size (N)	Sample size (S)	Population size (N)	Sample size (S)	Population size (N)	Sample size (S)
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

3.3 Exclusion Size

Throughout our data collection process, we have dealt with prior care to eliminate any kind of incongruity among the data given by any responded. We have checked every data whether it is from the online response or collected from the field survey before calculations. We have looked for the repentance of any car's data. To check that we have collected the registration number from every data.

We have checked if there is any missing information on the online response if so we have excluded that data. We did the same for every field survey data. We also looked for the faulty data by checking the mileage according to the registration and manufacturing year. Any type of unrealistic values about fuel consumption per liter was also excluded.

3.4 Research Instrument

That research is set up based on the survey consisting of different questions. These questions are used to derive answers that directly contribute data for the research objective. The questions are set up as simple and direct so that it is easier to answer them without any further confusion. The survey, both online and physical, are kept concise so that, it does not require more than several minutes to answer them.

3.4.1 Question 1 (Vehicle Model)

The first question in our questionnaire for conducting the survey work was about the specific vehicle model in possession of the owner. This question helped us to know the manufacturer of that certain vehicle with some other information attributed to each model. These data helped us to classify different vehicles under different sections in terms of the manufacturer. Later we could do some analysis to compare the performance among different vehicle models made by different manufacturers. At the same time, it was quite helpful to sort out which vehicle models were popular or preferred mostly by the buyers generally.

3.4.2 Question 2 (Registration year)

This second question of our questionnaire has been quite a vital one for different reasons. Registration year provides us the year from which the vehicle is running in our country. This question is indispensable to carry out the required calculations in this research work. A vehicle can have a long-time gap in between its manufacturing year and registration year in our country. That vehicle is in duty from the year of registration to the present time in our country. So, the fuel consumption made by the vehicle from the year of manufacturing to the year of registration is not our concern as that was not done in our country. Similarly, the energy produced by the combustion of fuel and the corresponding carbon dioxide emission in the process during that particular time period should not be included in our studies.

3.4.3 Question 3 (Manufacturing Year)

The manufacturing year of any vehicle speaks a lot about its performance, energy consumption, and carbon dioxide emission. Because with time the performance of any vehicle is supposed to deteriorate. That is why manufacturing year is one of the bases of performance analysis in our research work. Like the registration year of the vehicle it is another substantial factor to be addressed. If we do not know the year of manufacturing of any particular vehicle alongside its year of registration, we cannot find out how long the vehicle was in operation in some other country before coming to ours.

3.4.4 Question 4 (Engine Capacity)

Engine Capacity is also known as ‘Engine Displacement’. It means the area of displacement inside the piston cylinder from Top Dead Centre (TDC) to the Bottom Dead Centre (BDC) in a complete cycle of the engine. Engine capacity has a direct relationship with fuel consumption and further calculation reveals more data regarding energy consumption and GHG emission. In Bangladesh, there are a lot of vehicles plying the streets. These vehicles have various engine capacity and the most common unit to measure engine capacity in Bangladesh is cubic centimeter or cc. The most

common unit of engine capacity is 1500 cc and their fuel consumption rate is somewhat similar.

3.4.5 Question 5 (Total Mileage)

This question directly contributes to the actual kilometers that the vehicle has run for. The net mileage is the difference between the total mileage and the initial mileage. From the total mileage, total energy consumption, average fuel consumption, total GHG emission can be easily calculated. This question also gives an idea of the condition of the vehicle. If average daily run is known, it is possible to know the manufacturing year or the registration year of the vehicle. As the data can be directly extracted from the car dashboard, these data are by far the most accurate and used as standard for validating other corresponding data.

3.4.6 Question 6 (Initial Mileage)

In Bangladesh, a very common scenario that most vehicles that are running on the street, are reconditioned. So, at the time of registration in Bangladesh, there is some mileage to that car. In order to get an idea of the net mileage, it is imperative to know about the initial mileage of the vehicle when bought. The miles that have been traveled by this car, before being registered in this country, are not to be considered as the study scope only focuses on the vehicles that are running only in Bangladesh. Also, while validating the data initial mileage was used to cross-check the manufacturing here and registration year of the car.

3.4.7 Question 7 (Daily Runs)

This data fully relies on the driving experience of the driver. As most vehicles tend to run different mileage every day, the data recorded for this question is based on the average value the driver is providing. This data gives a brief picture of the average fuel consumption and GHG emission of the vehicle. The data also corresponds to average mileage by year which can be cross-checked by total mileage an initial mileage.

This data along with the fuel consumption and fuel preferences data provides an idea of traffic in Bangladesh. The average daily run is recorded in kilometer (km).

3.4.8 Question 8 (Fuel Preference)

Fuel preference is a very important question in our survey and research because different fools emit different types of GHG, and they have different energy consumption value. In Bangladesh the most common wait to differentiate between the vehicles is too know whether the vehicle has single fuel system or bi-fuel system. Single fuel vehicles mostly run on octane whereas a lot of cars also have CNG along with the octane which is also very common in Bangladesh. So, to differentiate the vehicles and also to direct the line of questioning for further investigation in the survey, this is very important information to know.

3.4.9 Question 9 (Gasoline Consumption Rate)

This question is for the responders who have chosen octane as their preferred fuel. These types of vehicles mostly run on single fuel mainly octane. This question enables to understand the efficiency of the vehicle in question with regards to its engine capacity, total mileage, and average daily run. It also points to the data to compare its efficiency with other vehicles also. For this survey the unit used for offering consumption rate is kilometer per liter (km/l). This data also helps to understand the factor of fuel preference in relation to pricing and cost of the fuel.

3.4.10 Question 10 (CNG Conversion Year)

This question is for the responders who have chosen octane and CNG, both fuel as their preferred fuel system. In Bangladesh, CNG is also a very popular preferred fuel system. To understand the daily run and mileage contributed by CNG, fuel consumption, energy consumption, etc. the conversion year is very important data. It helps to understand the years the vehicle has used octane as its primary fuel, and also the years that it has used bi-fuel system. In order to calculate and get a better idea to do a full comparison of both fuel systems, this data is an essential one.

3.4.11 Question 11 (Daily Run on Gasoline)

This is a similar question, as asked to the drivers who use octane as the only fuel system. The difference is, here, the octane is no longer a primary fuel, rather a part of the bi-fuel system. So, in order to calculate the energy consumption, fuel consumption, and GHG emission, it must be calculated separately. For that, the drivers are asked what portion of the average daily run uses octane, and from that the rest can be easily calculated.

3.4.12 Question 12 (Gasoline Consumption Rate, Bi-fuel System)

As both fuels are in use, the consumption rate of each fuel is needed to calculate and obtain the research objective. So, the question also involves the consumption rate of octane while the vehicle has both fuel systems. This provides a better idea of the comparison of fuel preferences of the drivers and also the energy consumption and GHG emission from those vehicles.

3.4.13 Question 13 (Daily Run on CNG)

This data can be easily obtained by the difference between the average daily run and the average daily run on octane. But as an extra precaution, the drivers are asked to make sure they give appropriate data so that we can easily validate the data that has already been provided. Natural gas is a very common fuel in Bangladesh, so daily run on CNG is highly usual for the vehicles.

3.4.14 Question 14 (CNG Consumption Rate)

Similar to the question regarding octane, the consumption rate of CNG is asked, to calculate the amount of energy consumed and GHG emitted by CNG usage. CNG being a popular fuel system, it is very common in Bangladesh, that is why it contributes to a significant amount of energy consumed and GHG emitted by different vehicles of Bangladesh.

3.4.15 Question 15 (Vehicle Registration Number)

To ensure that the data collected are properly validated and realistic the vehicle registration number has been collected from all the users to ensure that they have provided the data correctly best to their knowledge. It also ensures the quality of the data collected as vehicle registration number cannot be duplicated or fabricated which in turn translates that the data are not fabricated in any way. Also, these vehicle registration numbers are given based on manufacturing year and registration year, so it becomes easier to validate the data properly. The registration number also helps to identify any duplicate data, if there is any, which helps keeping the sample size accurately and the data reliability increases.

3.5 Survey Workflow

To understand and comply with the survey scope and objective, first Bangladesh traffic conditions and registered vehicles are checked. Fuel choices and their comparative usages are considered, and related journals, websites and research papers are thoroughly gone over. Then appropriate questions were set up which would yield the most useful data for the study. Then the survey was conducted on a social media platform through Google forms and also through physically interviewing drivers of different cars on the street. While interviewing, it was made sure that the data were collected from a wide variety of regions throughout Dhaka Metropolitan city. By effectively collecting the data, the data were sorted through and rearranged for the ease of calculation. After that, the results were shown graphically and discussed.

3.6 Average Fuel Consumption Rate

Both for gasoline and bi-fuel engine the way; of calculating the average fuel consumption is basically the same though for bi-fuel engine-based cars considering both fuels together are done in a little bit different way than gasoline engine because of considering the total consumption perfectly.

3.6.1 Gasoline Engine

The difference between the current mileage of any car and the initial mileage is the amount of distance that is being traveled by car in Bangladesh. As a huge number of cars in Bangladesh is reconditioned cars, the mileage showing on the dashboard is not totally the amount of distance that has traveled in Bangladesh. That is why the initial mileage is subtracted from the current mileage. The average distance traveled per year can be obtained through the following equation.

Average Distance Travelled per year,

$$M_{per\ year} = \frac{M_c - M_i}{Y_p - Y_r} \text{ km/year} \quad (1)$$

Where,

$M_{per\ year}$ = Average mileage of the vehicle per year

M_c = Current mileage of the vehicle

M_i = Initial mileage or mileage while registration of the vehicle

Y_p = Present year (2019)

Y_r = Year of registration

Average fuel consumption done by a vehicle per year can be done calculated using the average mileage of that particular vehicle per year. Diving that mileage with fuel consumption rate i.e. the average distance traveled in expense of one liter of gasoline will result in the average fuel consumption per year.

Average fuel (gasoline) consumption per year,

$$FC_{av,g} = \frac{M_{per\ year}}{FC_{rate}} \text{ L/year} \quad (2)$$

Where,

$FC_{av,g}$ = Average fuel (gasoline) consumption per year

$M_{per\ year}$ = Average mileage of the vehicle per year

$FC_{rate,g}$ = Average fuel (gasoline) consumption rate of the vehicle (km/L)

3.6.2 Bi-fuel Engine

For a bi-fuel engine, the average fuel consumption of gasoline and CNG is calculated separately. In Bangladesh as the car's engines are not made capable of running on CNG from the very beginning the cars are used here. That's why calculating the bi-fuel engine's average fuel consumption firstly the amount of fuel consumption by using gasoline before converting into CNG using engine is calculated. It is done like the same way only gasoline using engine's FC_{av} was calculated.

Average fuel (gasoline) consumption per year before CNG conversion,

$$FC_{av_1} = \frac{M_{per\ year}}{FC_{rate,g}} \text{ L/year} \quad (3)$$

Later after CNG conversion the amount of gasoline average consumption is calculated from the part of the distance that is driven by the gasoline from the total daily run. Then these two values for gasoline are averaged together considering the weight of each of the values to find the total gasoline average fuel consumption of any bi-fuel engine cars.

Average fuel (gasoline) consumption per year after CNG conversion,

$$FC_{av_2} = \frac{D_g}{D_T} \times \frac{M_{per\ year}}{FC_{rate,g}} \text{ L/year} \quad (4)$$

Where,

D_g = Distance traveled using gasoline per day

D_T = Total distance traveled in a single day

Total average fuel (gasoline) consumption per year,

$$FC_{av,g} = \frac{FC_{av_1} \times (Y_c - Y_r) + FC_{av_2} \times (Y_p - Y_c)}{Y_p - Y_r} \text{ L/year} \quad (5)$$

Where,

$Y_p =$ Present year (2019)

$Y_r =$ Year of registration

$Y_c =$ Year of CNG conversion

$FC_{av_1} =$ Average fuel consumption of gasoline before CNG conversion

$FC_{av_2} =$ Average fuel consumption of gasoline after CNG conversion

To calculate the average CNG consumption, the distance run by CNG from the daily run is taken under consideration. The rest of the procedure is the same as calculating gasoline's average fuel consumption.

Average fuel (CNG) consumption per year,

$$FC_{av,CNG} = \frac{D_{CNG}}{D_T} \times \frac{M_{per\ year}}{FC_{rate,CNG}} \quad \text{m}^3/\text{year} \tag{6}$$

Where,

$D_{CNG} =$ Distance traveled using gasoline per day

$D_T =$ Total distance traveled in a single day

$FC_{rate,CNG} =$ Average fuel (gasoline) consumption rate of the vehicle (km/m^3)

3.7 Energy Consumption of Vehicles in Dhaka

Energy consumption depends on the amount of the average fuel consumption and the energy conversion factor of the fuel that we are considering. These conversion factors are taken from the MIT Units & Conversions Fact Sheet[41].

3.7.1 Gasoline Engine

1 L of gasoline contains 32.1 MJ energy = 0.0321 GJ energy.

We know, 1 kWh = 3.6 MJ =3.6×10^{-3} GJ

Therefor, 1 GJ = 277.778 kWh

So, 0.0321 GJ = 8.91667 kWh

Now, we have, the energy consumption of gasoline per year

= $FC_{av,g} \times$ 8.91667 kWh

Where, $FC_{av,g} =$ Average fuel (gasoline) consumption per year

3.7.2 Bi-Fuel Engine

In the same way, we have calculated the energy consumption of gasoline the energy consumption of CNG is calculated.

1 m^3 of CNG at standard temperature and pressure contains 38.2 MJ energy = 0.0382 GJ energy.

We know, 1 kWh = 3.6 MJ =3.6×10^{-3} GJ

Therefor, 1 GJ = 277.778 kWh

So, 0.0382 GJ = 10611 kWh

Therefore, the energy conversion of CNG per year

= $FC_{av,CNG} \times$ 10.611 kWh

Where, $FC_{av,CNG} =$ Average fuel (CNG) consumption per year

3.8 Green House Gas Emission by the Vehicles in Dhaka

Green House Gas (GHG) emission also depends on the average fuel consumption and how much a unit of the fuel emits GHG in the environment. This conversion factor is taken from the MIT Units & Conversions Fact Sheet[41].

3.8.1 Gasoline Engine

While producing 1 GJ of energy from gasoline, 67.2 kg of CO_2 is produced.

So, 0.0321 GJ creates (67.2 $\times$ 0.0321 kg) of CO_2

= 2.157 kg of CO_2

Therefore, the average GHG emission per year for gasoline

= $FC_{av,g}$ × 2.157 kg of CO_2

Where, $FC_{av,g}$ = Average fuel (gasoline) consumption per year

3.8.2 Bi-Fuel Engine

While producing 1 GJ of energy from CNG, 50.3 kg of CO_2 is produced.

So, 0.0382 GJ creates (50.3 × 0.0382) kg of CO_2

= 1.92 kg of CO_2

Therefore, the average GHG emission per year of CNG

= $FC_{av,CNG}$ × 1.92 kg of CO_2

Where, $FC_{av,CNG}$ = Average fuel (CNG) consumption per year

3.9 Energy Cost

While using any type of energy, its cost matters also. As the amount of the total energy in the earth is fixed and it is decreasing at a quicker rate than any other time in human history. Throughout the year, based on many factors the price of fuel is a great example of the energy that the people use changes.

In Bangladesh, as a developing country, there is a big chunk of subsidy from the country's annual budget for the energy sector. Still the price is high enough and increasing based on many factors.

According to the Bangladesh Energy Regulation commission, from July 1 of 2019, the price for one cubic meter of CNG is BDT 43[42]. Per liter of gasoline costs BDT 89[43] on 17th November, 2019. It also changes in various conditions. For this research, analyzing the cost of energy used by the vehicles are done based on these fuel cost price.

Chapter 4 Results and Discussion

4.1 Survey Response

4.1.1 Number of cars with respect to car models

In the conducted survey a question was asked querying about the car models. After accumulating all the data, it has been found out that in Bangladesh, the most common car models are Toyota Corolla X, Toyota Allion, Toyota Axio, Toyota Premio, and Toyota Noah. The most common variants of cars that have been encountered are the Toyota Corolla variants. Besides these, different car models such as Audi, BMW, Hyundai, Honda, Mitsubishi, etc. have also been encountered, these different models make up only a small percentage of the total sample size, so it can be safely assumed that the most common car model in Bangladesh is Toyota. The following graph shows a more simplified data showing different car models and then numbers.

Figure 9. Number of private cars of each model included in our survey work

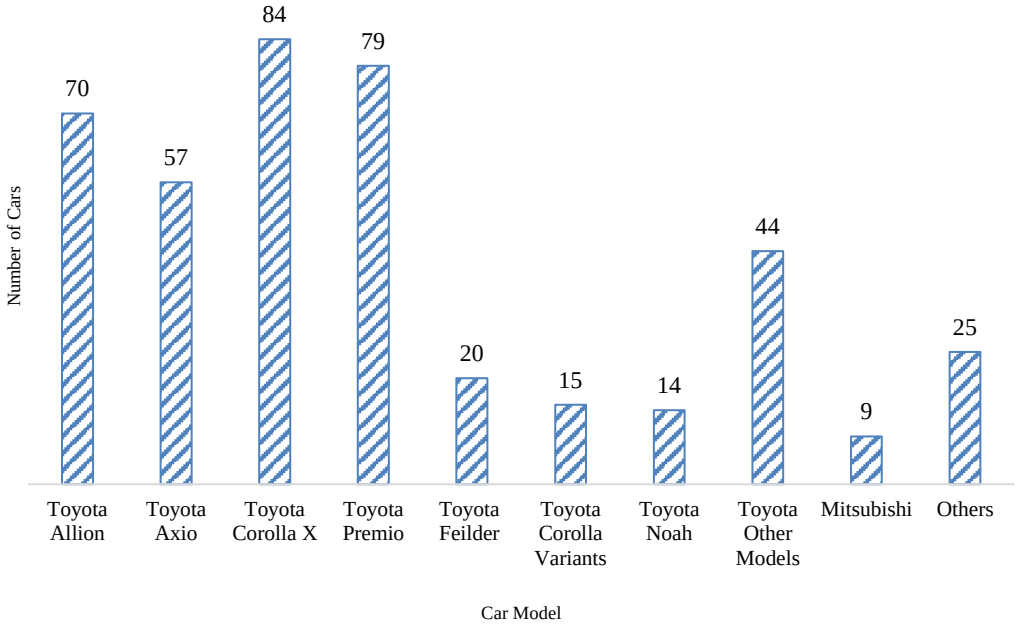

Figure 10: Number of cars with respect to generalized models

4.1.2 Number of cars based on the manufacturing year

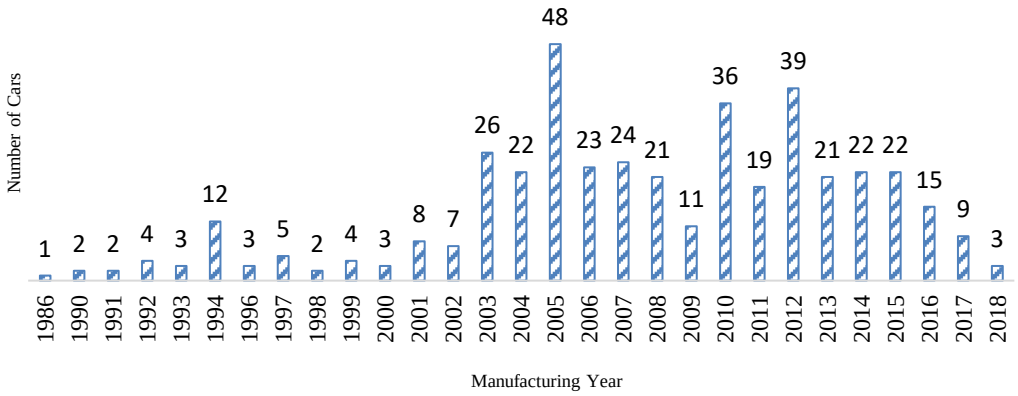

Figure 11. Number of private cars in operation in Dhaka city manufactured in different years within our survey

Knowing the manufacturing year of the cars included in the sample is very important to comment on their full preferences. The older the car manufacturing year, the more fuel it appears to consume because over the years, the car loses efficiency. Most car owners prefer to buy vehicles that have been manufactured in the years 2003

to 2012. This is because of the fact that the cars manufactured in between these periods were imported with the lower tax rates and the cars bought within that period, would impose a lower tax burden on the owner. But due to the increase of personal tax, sales tax, and import tax, there has been a declination in the cars that had been recently manufactured (mostly made after 2012) and most cars that are being bought and sold, just change the owners within the country.

4.1.3 Number of cars based on registration year

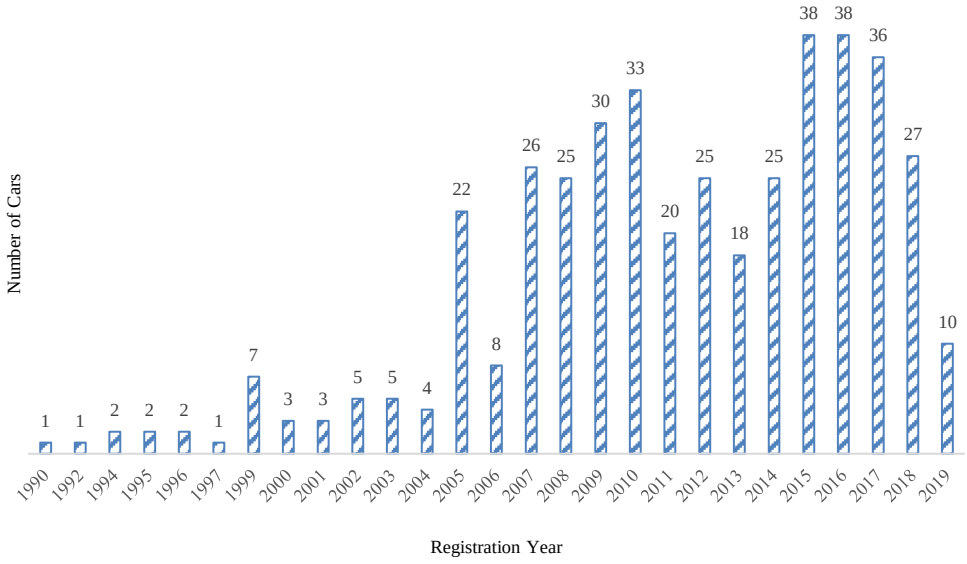

Figure 12. Number of private cars registered in the different year running in the streets of Dhaka within our survey

These data indicate the number of cars registered in a year. It can be seen from the data that the older model cars are barely on the streets, although after 2004, there has been a sudden rise of vehicle owners which indicates a pattern of economic growth and financial improvement. The most car models that are on the street are registered mostly in between 2005 to 2012. These data coincide with Bangladesh's economic growth, where Bangladesh sees growth in the years 2005 and onwards in different industries[44]. We can see that there has been a decline in car registration in recent years. This is due to the fact that there has been an increase of taxes on personal income and new vehicles[45] and a sudden rise in the fuel cost. Also, as all the data are

collected in 2019, it is highly unlikely that we would get a reasonable number of cars registered during that same year.

4.1.4 Number of cars based on year of CNG conversion

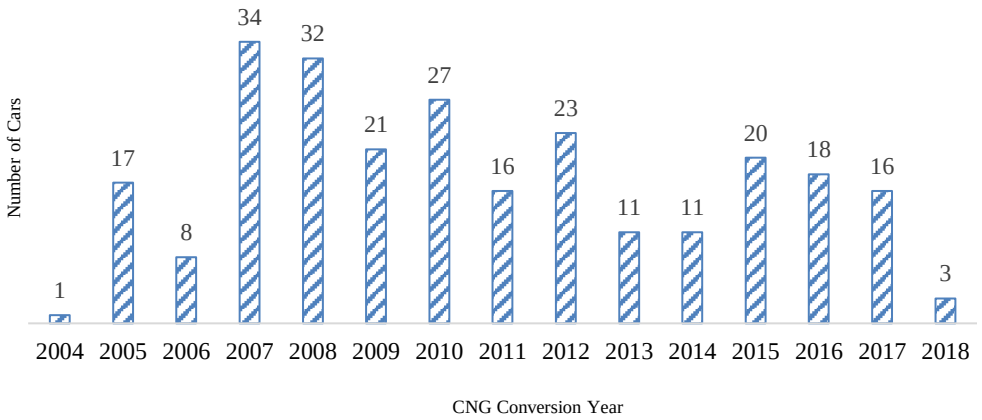

Figure 13. Number of bi-fuel private cars within our survey based on its year of CNG conversion

Although CNG conversion was first introduced in 1995 in Bangladesh, it became highly popular in the early 2000s. That is why, in the data, it can be seen that in the years 2005 to 2012, when the cars were highly registered, they all have been converted to CNG. This is due to the fact that the government had taken steps to reduce the carbon footprint and also lessen the dependency on petroleum and gasoline-based fuel. At the same time the government wanted to popularize CNG, by introducing CNG based auto-rickshaws and mandatory retrofitting in all government vehicles. The government also encouraged the conversion of private vehicles by exempting import duty on CNG conversion kits and CNG storage cylinders while increasing the cost of gasoline which were previously subsidized[46].

4.1.5 Number of cars based on engine capacity

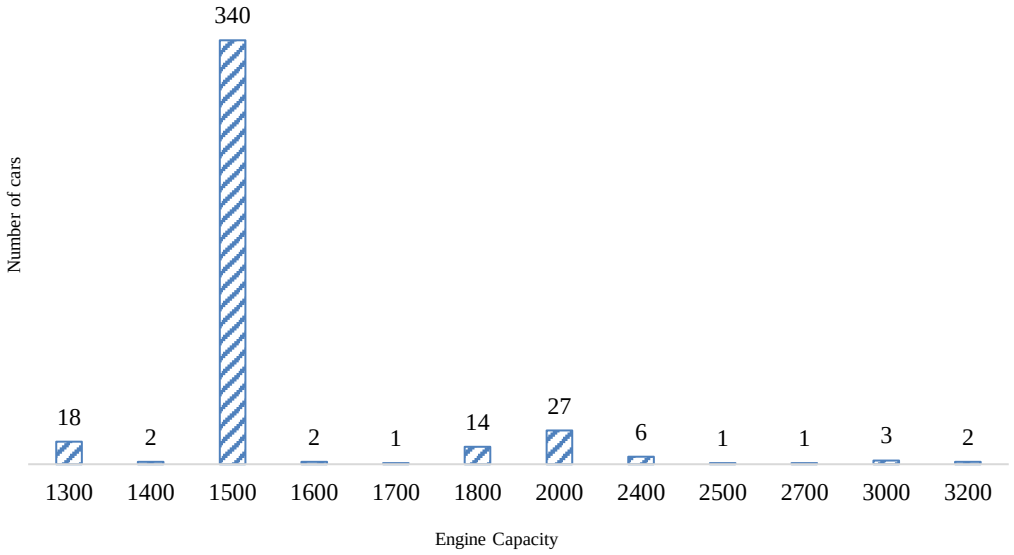

Figure 14, Number of private cars within our survey based on engine capacity

From the above graph it can be seen that, of the 417 responds, more than 81% of it owns a vehicle of 1500cc engine capacity. From the previous graph that contained the number of cars according to the model, it is gleaned that Toyota Allion, Toyota Corolla X, Toyota Axio, Toyota Premio, etc. were the most popular car models in Bangladesh and they all have engines of 1500 cc capacity. There are also some cars with 1300 cc's which belong to previous Toyota variants. There are also some cars that have engine capacity of 1800 cc or 2000 cc. These cars are mostly SUVs or Jeep type cars. These cars along with other engine variants are mostly imported cars that are not very common in Bangladesh. Most of these brands include Audi Mitsubishi or Hyundai. There are also some Toyota vehicles such as Toyota Prado or Toyota Noah.

4.1.6 Number of cars based on fuel preferences

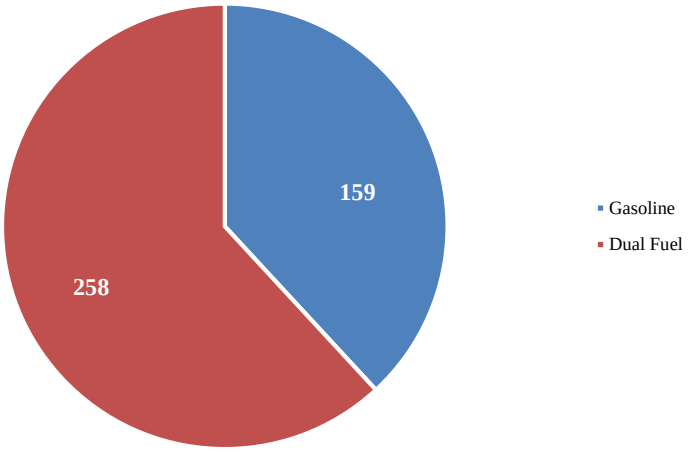

Figure 15. Number of private cars within our survey based on fuel preference

These data simply project the choices of vehicle owners regarding their fuel. It is noticeable that a large number of vehicles run on both octane and CNG. In Bangladesh, the cars that are imported generally have gasoline as their primary fuel. After they are registered in Bangladesh, they are retrofitted with the CNG conversion kit. The car owners to convert their vehicles to CNG mostly use CNG as the primary fuel and keep gasoline as backup in case there CNG storage is depleted. The drivers also stated that they use gasoline at the beginning of the day and at the end of the day just to keep the engine running smooth. While the rest of the day, when the car is in traffic jams or on the run, along with the auxiliaries such as the air conditioning, the radio, the navigators, the charging port, etc. runs mostly on CNG.

4.1.7 Comparison between Online and Physical Survey

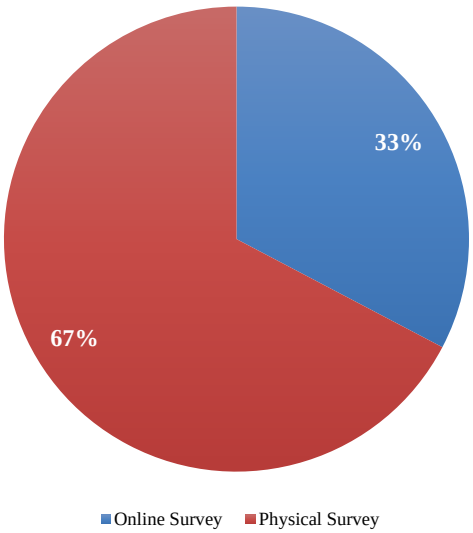

Figure 16. Comparison between Online and Physical Survey

We have obtained one-third of the total response in our online survey. The rest of the two-third have been collected by physical surveys in the following places in Dhaka city.

- Uttara
- Banani
- Gulshan
- Mirpur
- Sher-e-Bangla Nagar
- Panthapath
- New Elephant Road
- Motijheel

All these places are scattered on the whole map of Dhaka city. We have done the physical survey in all those places to include the scenario of every region within Dhaka city.

4.2 Fuel Preferences Based on different Car Models

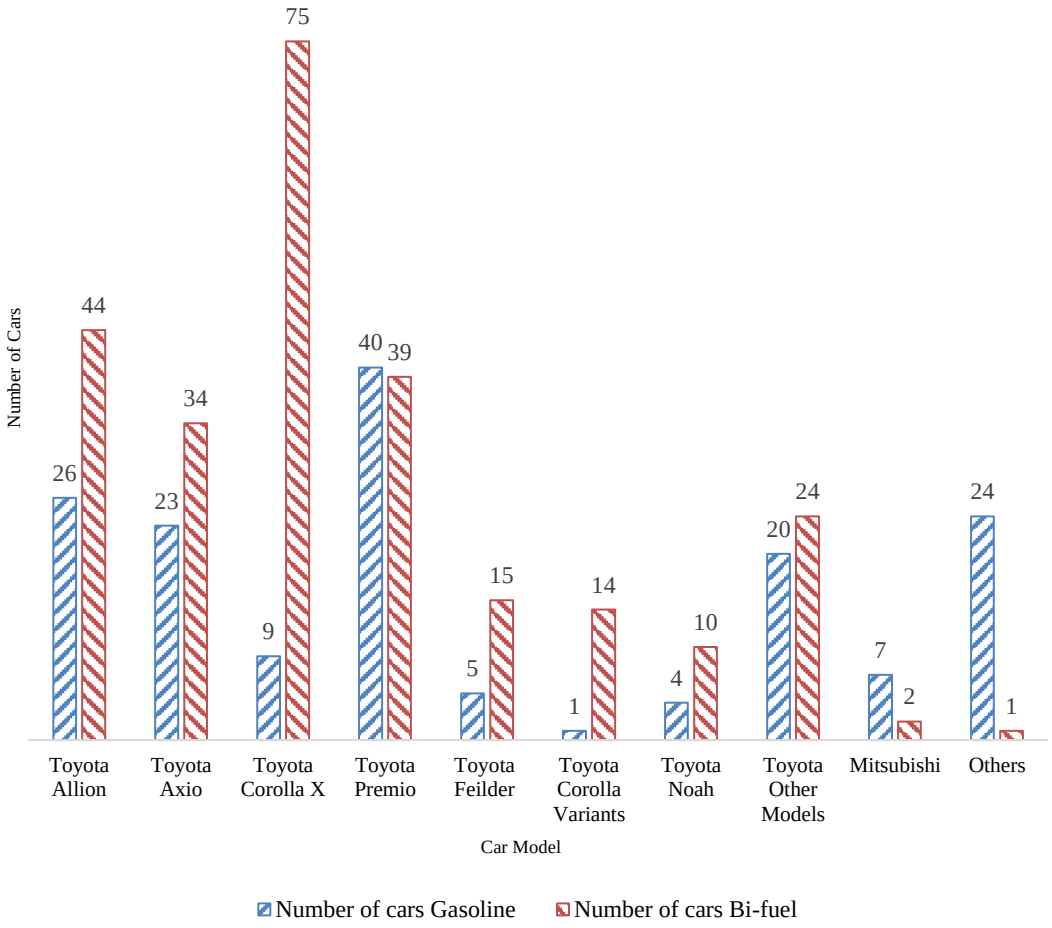

Figure 17. Fuel Preferences of different Car Models

These data represent the fuel preferences of car models. Based on their numbers it can be observed that; Toyota Corolla X is the most vivid user of both fields system comparing to using only or gasoline as the primary fuel. If the popular car models, such as, Toyota Allion, Toyota Axio, Toyota Premio, are looked at,it can be derived that CNG conversion is the most popular choice among Bangladesh car owners which is also demonstrated in the previous full preferences of the total sample size graph. It is also noticeable, the cars that are of exotic brands such as Audi, BMW, Mitsubishi, etc. Mostly prefer gasoline as their primary fuel system.

4.3 Fuel Preferences Based on different Car Manufacturing Year

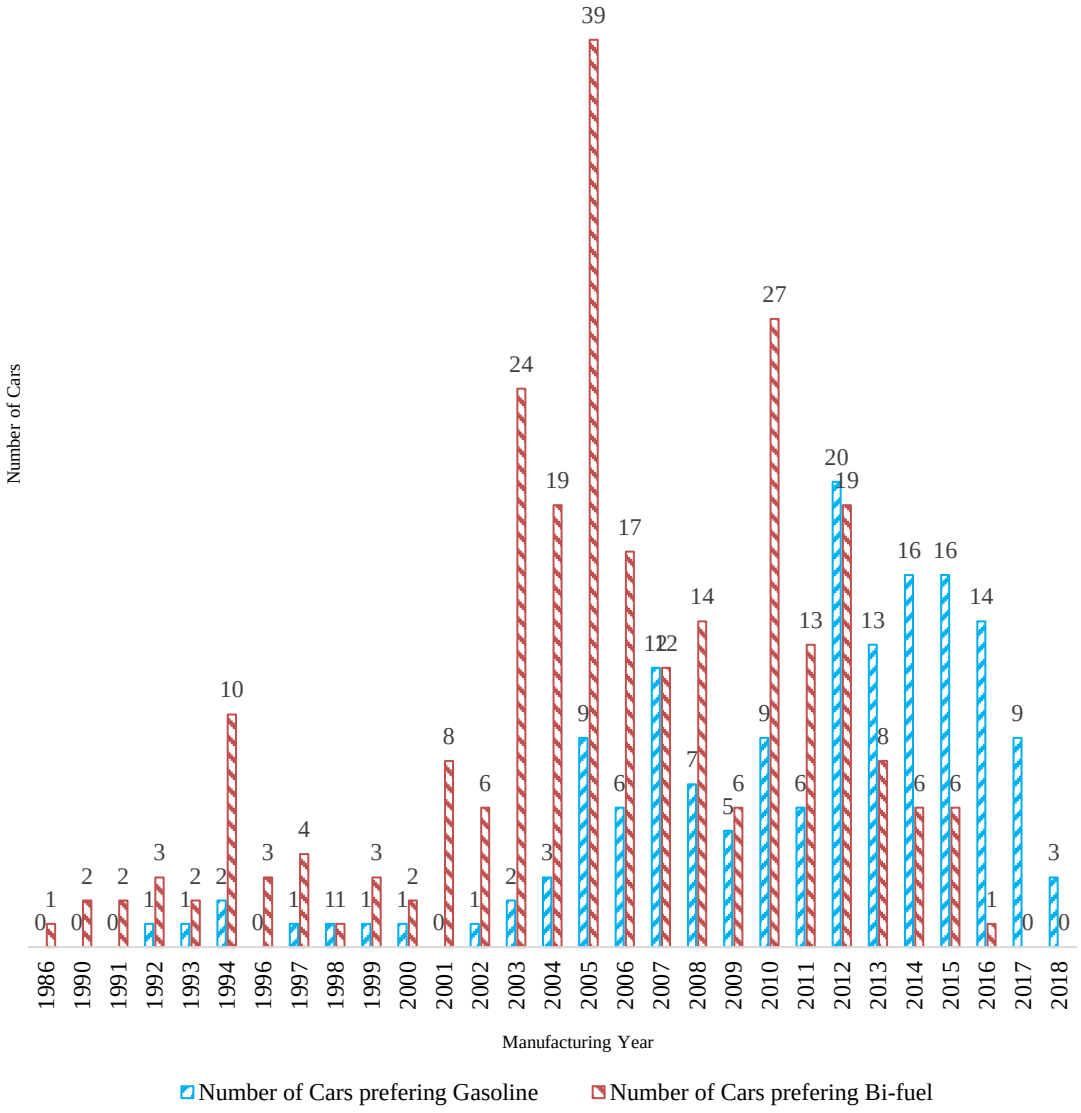

Figure 18: Fuel Preferences of Cars in different manufacturing models

Here the fuel preferences of different cars as shown based on their manufacturing year. The manufacturing models from the earlier 20th century are mostly converted to CNG. But in the later years, there is a trend of preferring a single fuel system over dual fuel system. This has been the result due to the fact that there has been a sudden increase in natural gas prices which is made it less desirable to convert the vehicle to CNG. Since most of the cars that are imported into the country are previously set to

run on octane, converting it to CNG reduces engine efficiency. Previously the reduced cost of fuel justified the loss in efficiency but in recent years due to an increase in traffic jams, it is hardly justified to reduce the efficiency of the engine, where the engine is already consuming more fuel. That is why in recent years it is a good practice to keep the vehicle in a single fuel mode to keep the engine efficiency long-lasting. It is also noticeable that the models manufactured in 2005, has the highest rate of conversion to CNG. This is because, in Bangladesh, Toyota Corolla X 2005 model became very popular in choice due to its pricing and other facilities, CNG conversion being the popular practice most of these cars have been converted to CNG along with many other models. It is also noticeable that the 1994 models have also some Toyota Corolla X model which was very popularly converted to CNG.

4.4 Average Fuel Consumption

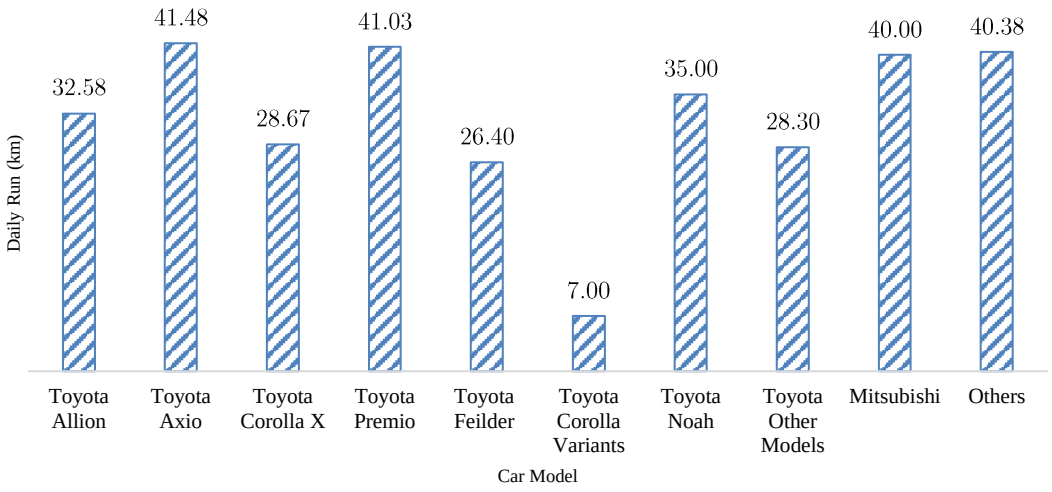

Figure 19. Average Daily Run versus Car Model

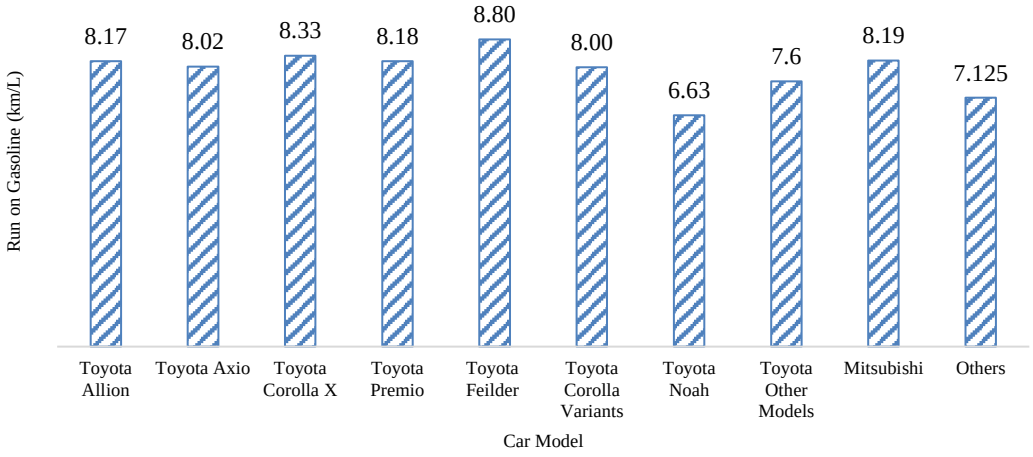

Figure 20: Average run on per liter Gasoline versus car model

Here the fuel consumption rate is calculated as how much distance a vehicle can cover on unit amount of gasoline. So, the higher the value is the more efficient the car is. Here it is seen that the common Toyota models have higher value.It is because of the fact that the most recent variants of these models have highly efficient engine which allows it to cover more distance at unit amount of fuel. Here Toyota fielder, where some variants of it are hybrid, can cover the most distance on unit amount of fuel. Some exotic models have a higher engine capacity which allows it to consume more fuel to cover the same amount of distance. That is why these vehicles are showing fewer values.

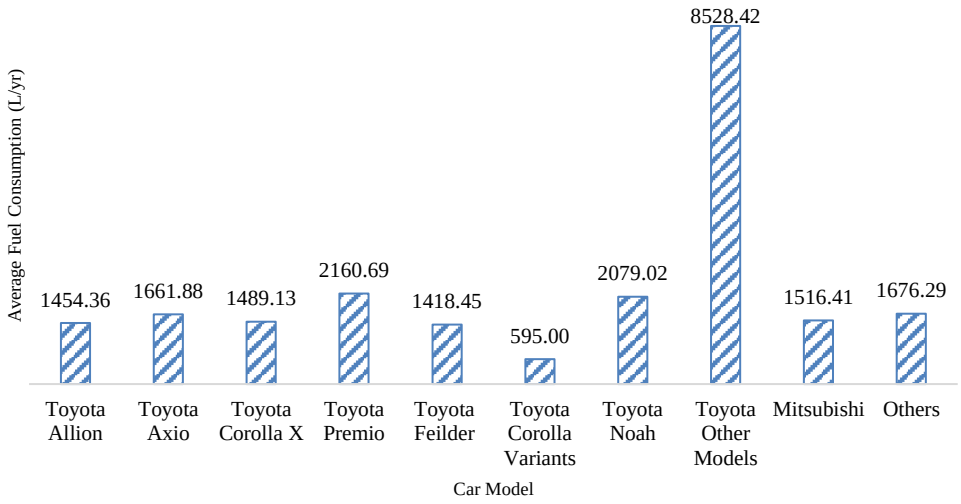

Figure 21: Average fuel consumption per year versus car model (For Gasoline)

Here the graph illustrates a scenario of how much fuel is consumed throughout the year by different car models. A point to be noted is some Toyota variants have high fuel consumption per year. These cars have been running on the road since the late 90s that is why their average mileage is higher than other car models. Although they have an average fuel consumption higher than anyone else, they are very low in number, which is why while taking into consideration, this sudden uprise has been neglected and it was mostly focused on the common car variants there are running on the streets. Which is why the cars with 1500 cc engine capacity is mainly considered for comment upon. Although we can also see some exotic cars have higher fuel consumption rate since they have a large engine capacity.

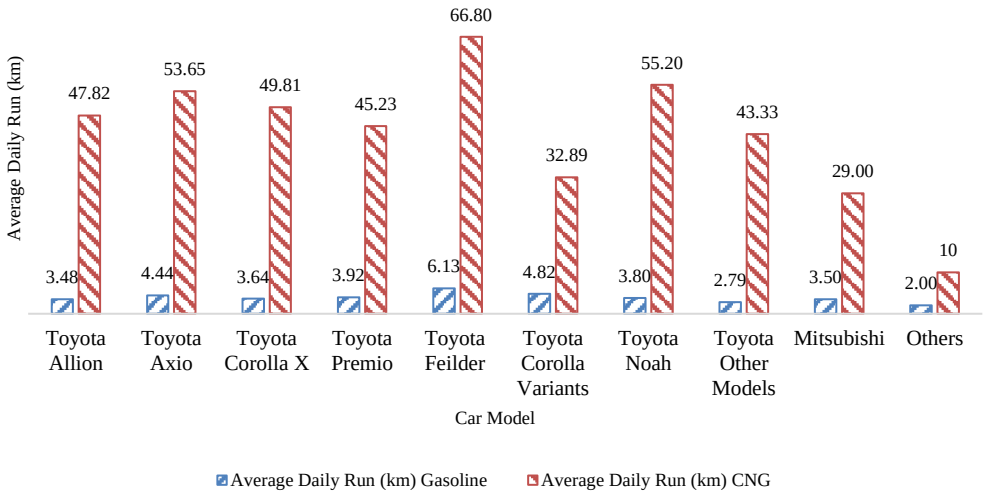

Figure 22: Average daily run versus car model (For Bi-Fuel)

Previously it has been stated that the dual fuel system cars are the ones that were previously gasoline-based later on converted to CNG. So, these cars run both on gasoline and CNG. In this graph we noticed an important point. Even though the cars can run on both fuel the drivers are mostly running on CNG rather than gasoline. In an investigation to know more about this, while serving for data, we casually asked different drivers of their fuel preference. It was found out that most car drivers use gasoline as a backup fuel system and use it just to start the engine for a smoother run. But the major operation of the car is most relied on CNG which what is the data shows.

Hear the Toyota filter has the highest daily one among all and also, we can see that the common Toyota variants are still dominating the streets.

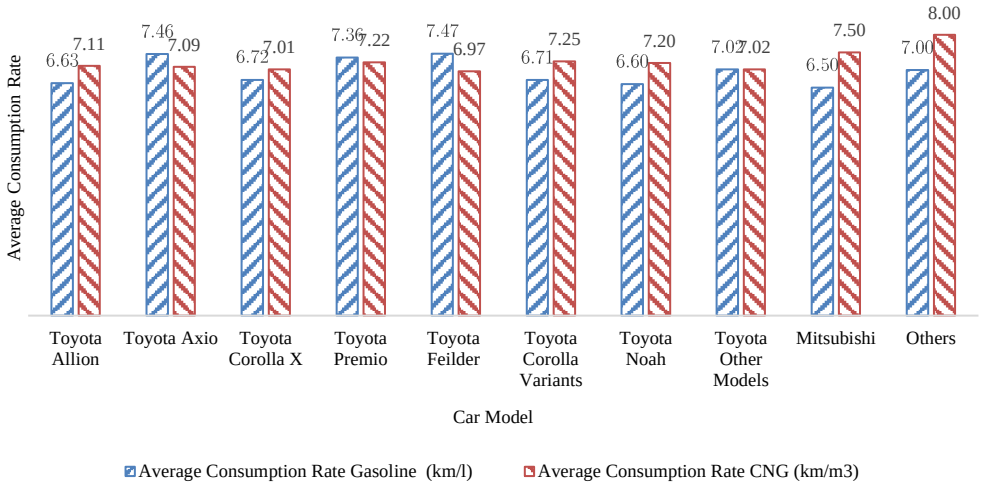

Figure 23: Average fuel consumption rate versus car model (For Bi-Fuel)

Fuel consumption is calculated based on how many kilometers the car can run on a unit amount of fuel. For gasoline it is calculated per liter while for CNG it is calculated per cubic meter. On average most cars run up to 6 to 7 kilometers per liter of gasoline and 7 to 8 kilometers per cubic meter of CNG.

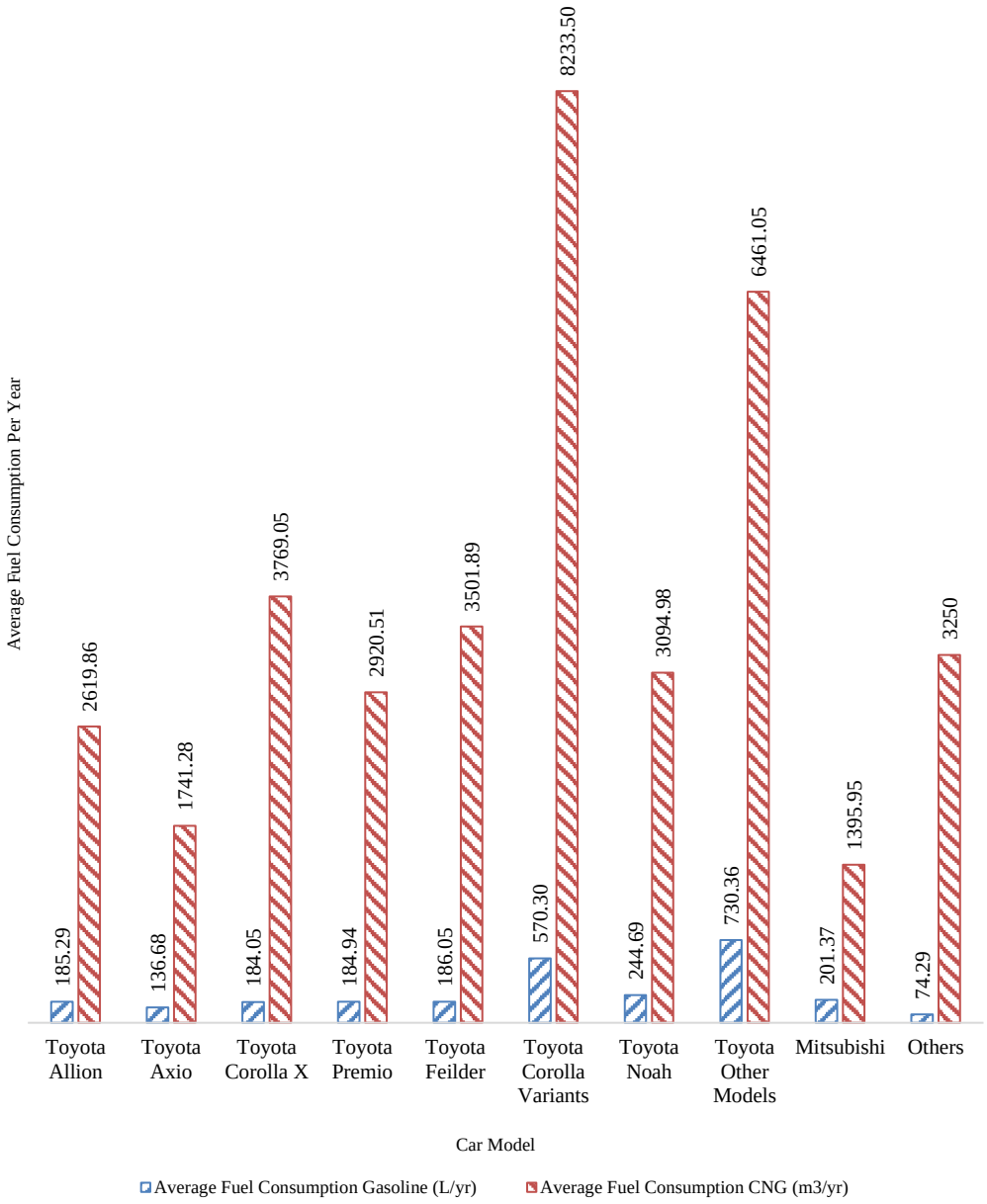

Figure 24: Average fuel consumption per year versus car model (For Bi-Fuel)

Here also a similar trend to the previous graph can be observed. This graph shows the popularity of CNG as preferred fuel among Bangladeshi car owners. This is due to the fact that CNG costs a lot lower compared to gasoline. Here the Toyota Corolla variants have a higher fuel consumption rate because most of these cars are very old models and to reduce cost most of the car owners have converted it to CNG which allows it to consume more fuel due to low efficiency. The gasoline consumption rate is also higher compared to other car models. Among the common Toyota models,

Toyota Corolla X has the highest CNG consumption rate because most of the car models are registered during the years when CNG conversion was a very popular choice among the car owners. Which is why they have a higher fuel consumption rate per year.

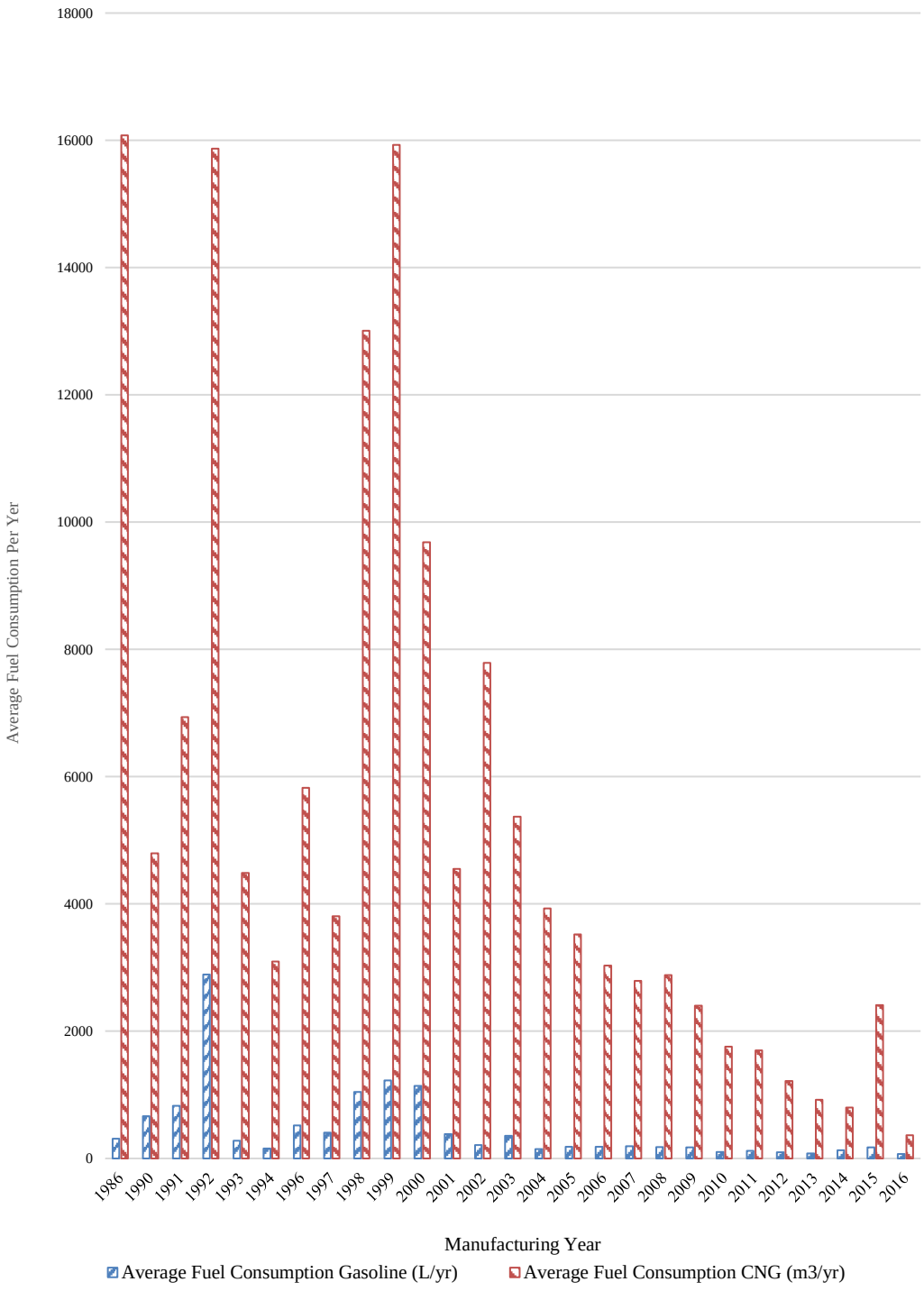

Figure 25: Average fuel consumption per year versus car Manufacturing Year (For Bi-Fuel)

Comparing the average fuel consumption of gasoline and CNG,it is clear that CNG has a way higher fuel consumption rate over gasoline. As the people of Bangladesh have a higher tendency to run their car on CNG over gasoline, the average fuel consumption rate is much higher than gasoline in every manufacturing year taken under consideration. As the car's engine loses its efficiency over year older cars have a high rate to use CNG more than the latest cars. In 90's car which is still running around using CNG more than gasoline. From the data, the highest average CNG consumption rate was 16077.50 L/year in 1986 manufactured year cars, this may be also because less data was found from this manufacturing year cars too. In the manufacturing year 1992, the highest gasoline consumption rate was recorded 2890.71 L/year.

4.5 Average Mileage

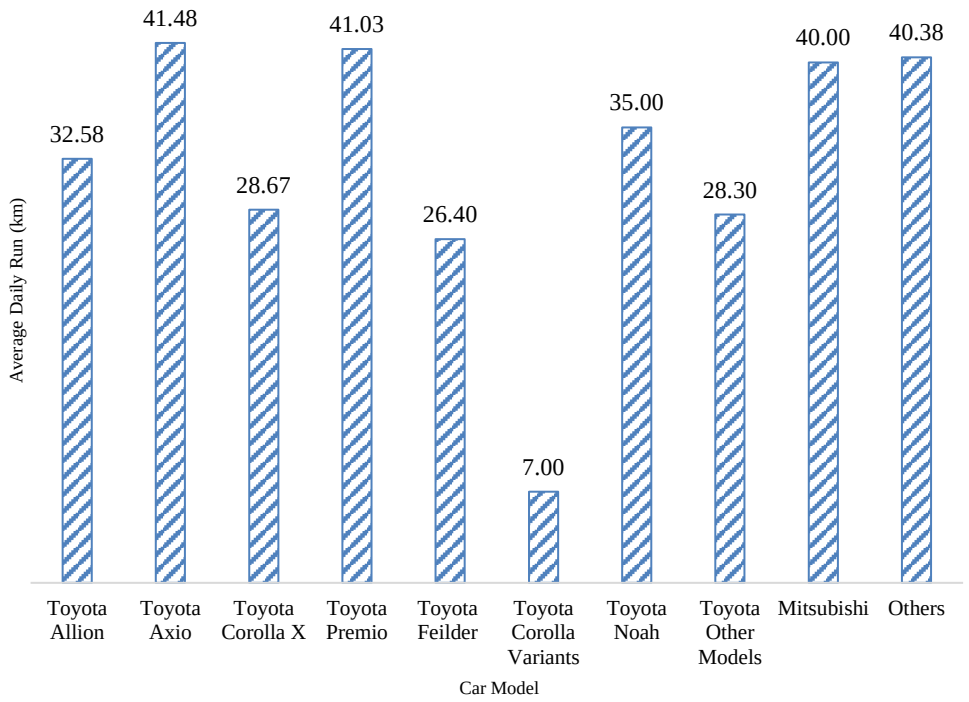

Figure 26: Average daily run versus car model (Gasoline)

The graph shows a picture of the cars that are plying on the streets of Bangladesh. As stated before, these data also verify the common car models of Bangladesh are Toyota

Allion, Toyota Axio, Toyota Premio, Toyota Corolla X, etc. Here the Toyota Corolla variants are mostly order models. So, their engine consumes more fuel than the recent models. Which is why they have a lower average daily run compared to other car models. Most Corolla X model cars have CNG installed, which is why they have low average daily run on gasoline.

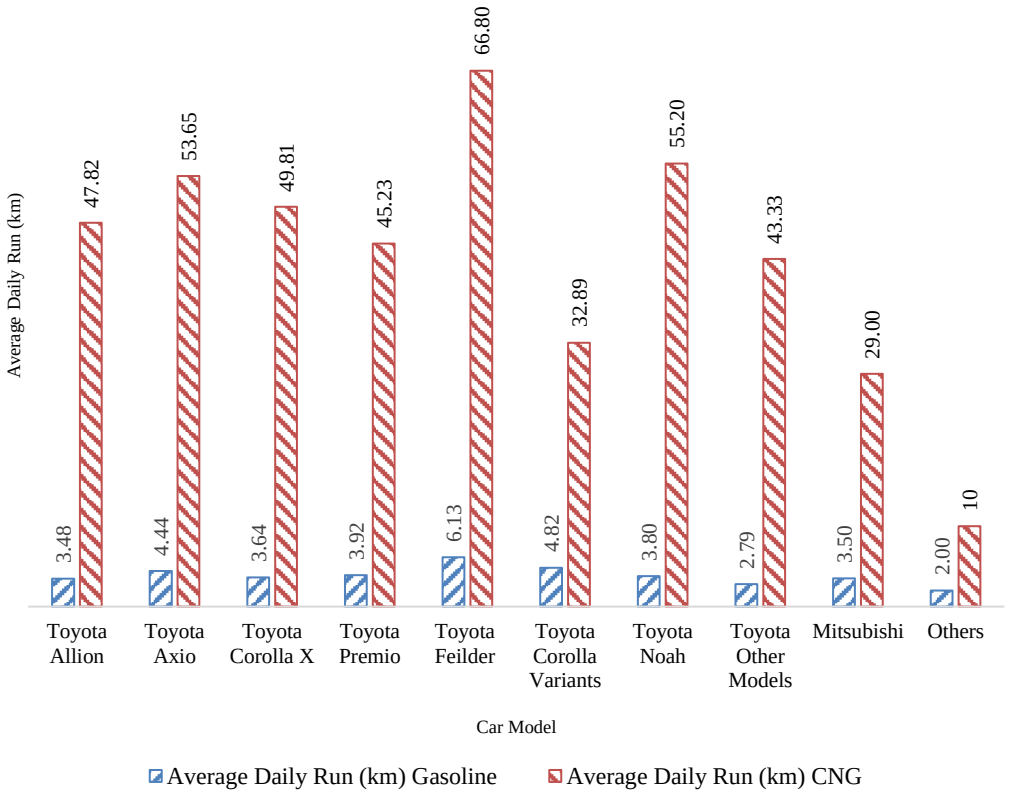

Figure 27: Average daily run versus car model (For Bi-Fuel)

Previously it has been stated that the dual fuel system cars are the ones that were previously gasoline-based later on converted to CNG. So, these cars run both on gasoline and CNG. In this graph, an important point can be noticed. Even though the cars can run on both fuel the drivers are mostly running on CNG rather than gasoline. In an investigation to know more about this, while serving for data, the drivers of different cars were casually asked of their fuel preference. It was found out that most car drivers use gasoline as a backup fuel system and use it just to start the engine for a smoother run. But the major operation of the car is most relied on CNG which what is

the data shows. Hear the Toyota filter has the highest daily one among all and also, it can be seen that the common Toyota variants are still dominating the streets.

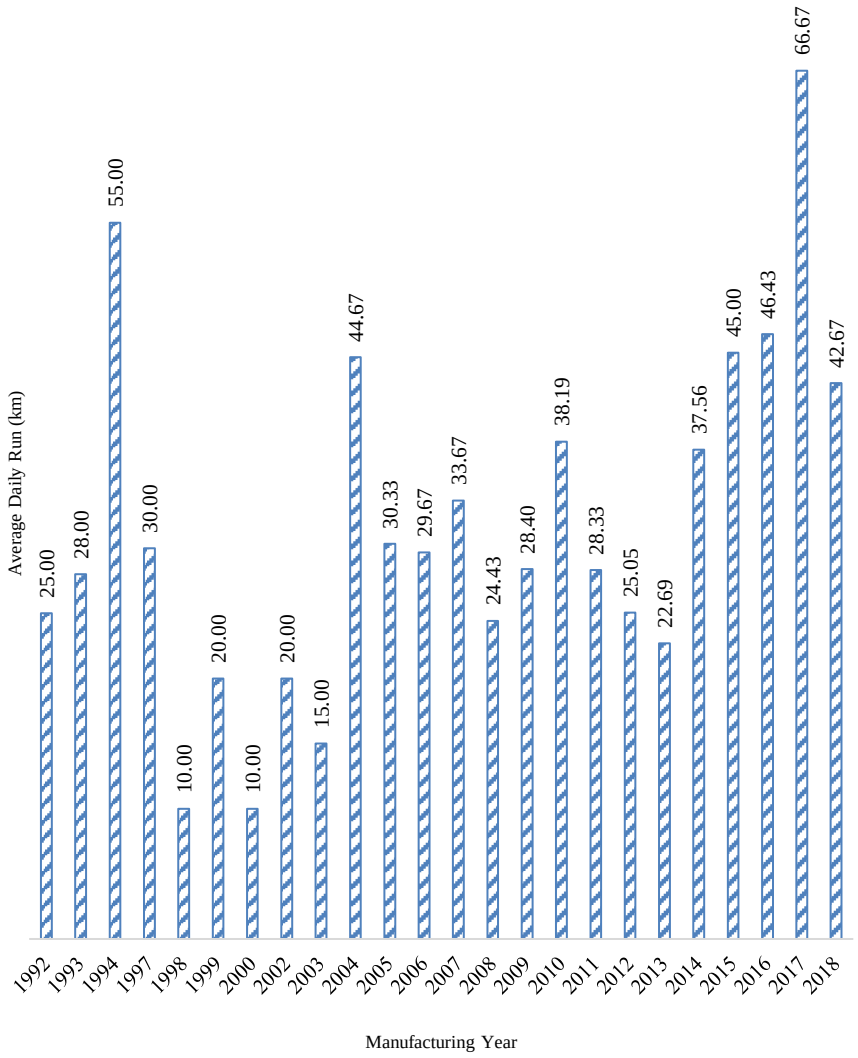

Figure 28: Average daily run versus car Manufacturing Year (For Gasoline)

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Here average daily run is shown for different car models manufactured in different years. The daily runs have been on an increasing trend in recent years manufactured models on gasoline. This is due to the fact that the most recent manufacturing models have a tendency to keep the engine efficiency as it is, and so most of these cars kept running on octane. It is noticeable that the 1984 models have an average daily run higher than it's consecutive before and after years. This is due to the fact that the 1994 Corolla X models are still most common cars in street, and they are running up to 100 kilometers a day.

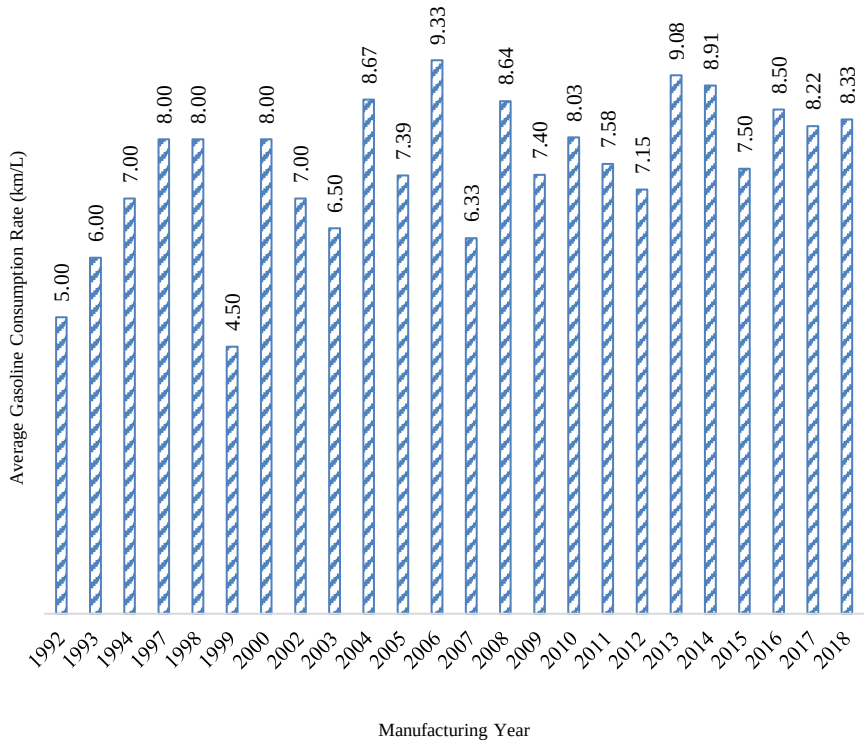

Figure 29: Average fuel consumption rate versus car Manufacturing Year (For Gasoline)

In this graph of data, it can be observed that the increasing tendency of the average consumption rate of the vehicles when the fuel is gasoline. In previous years like ’90s or early 2000 this rate was not that significant. Though from the collected data, it is clear that the cars manufactured in 2006 have the highest value of 9.33 km/L consumption rate. In recent years the data became more stable around 8 km/L. Modern technology has a great impact on the average fuel consumption rate. This data varies from manufacturing company to company but overall in the same year, this result remains kind of same.

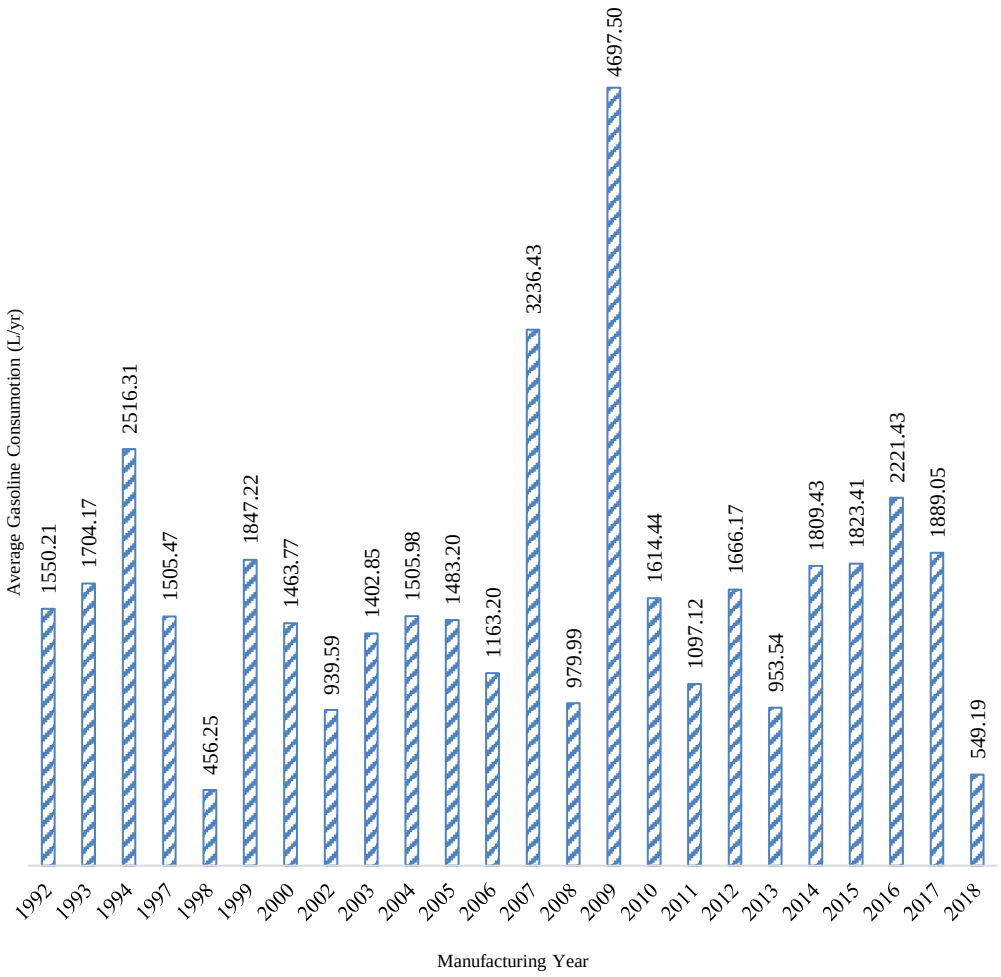

Figure 30: Average fuel consumption per year versus car Manufacturing Year (For Gasoline)

These data show the average fuel consumption per year in this case gasoline. Here those cars that were made in 2009 have the highest fuel consumption per year which is 4697.50 L/year. These data show that in recent year's manufactured cars this rate is low. It can be due to increase in efficiency of the engine and overall automobile industry. This rate mainly depends on the driving behavior of the driver also. Regardless of the manufacturing year how much the drivers drive the car makes impact on the result.

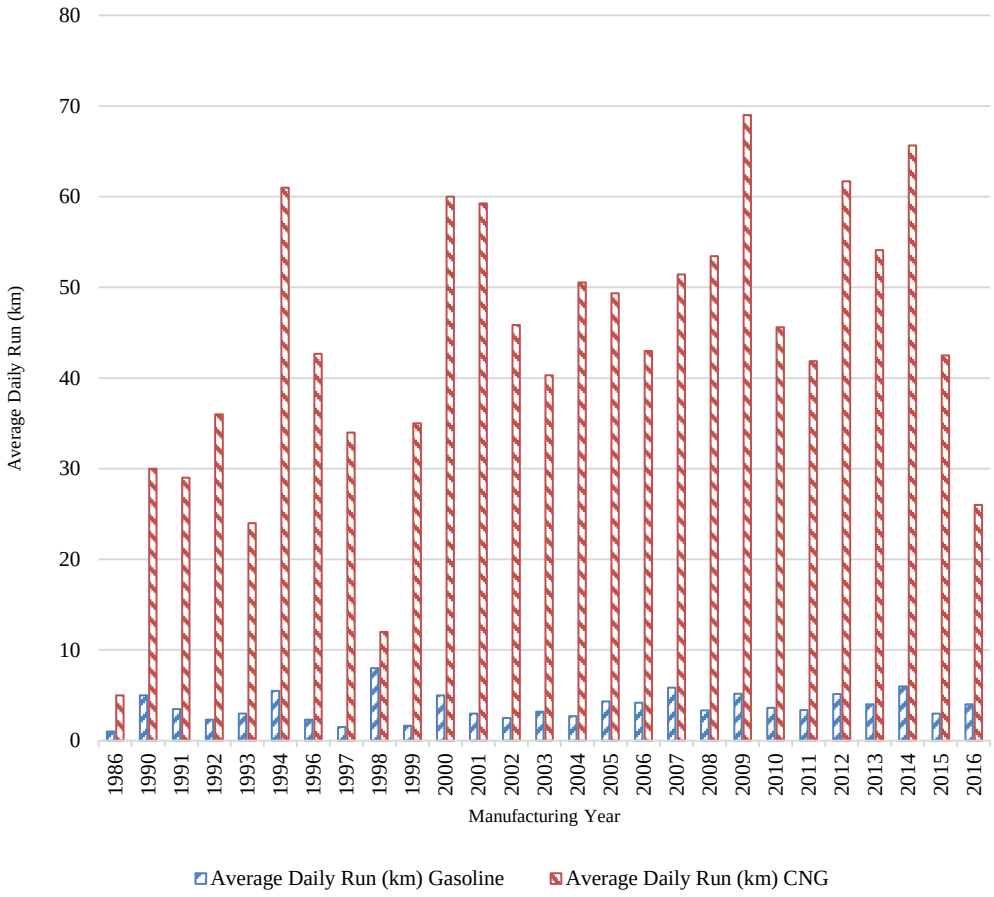

Figure 31: Average daily run versus car Manufacturing Year (For Bi-Fuel)

The average daily run of any car depends totally on the driving behavior and necessity of the driver of any car. In our country almost all the cars that are running on dual fuel means gasoline and CNG peoples have tendency to drive mostly on CNG. Due to mainly economical aspects CNG is preferable over gasoline that's why these data clearly show this preference. Over every manufacturing year this is the same output. In the year 2009 we can see that in the manufacturing year 2009 we have the highest average daily run 96 Km and the manufacturing year 2014 we have the highest gasoline using average daily run 6 Km.

4.6 Energy Consumption

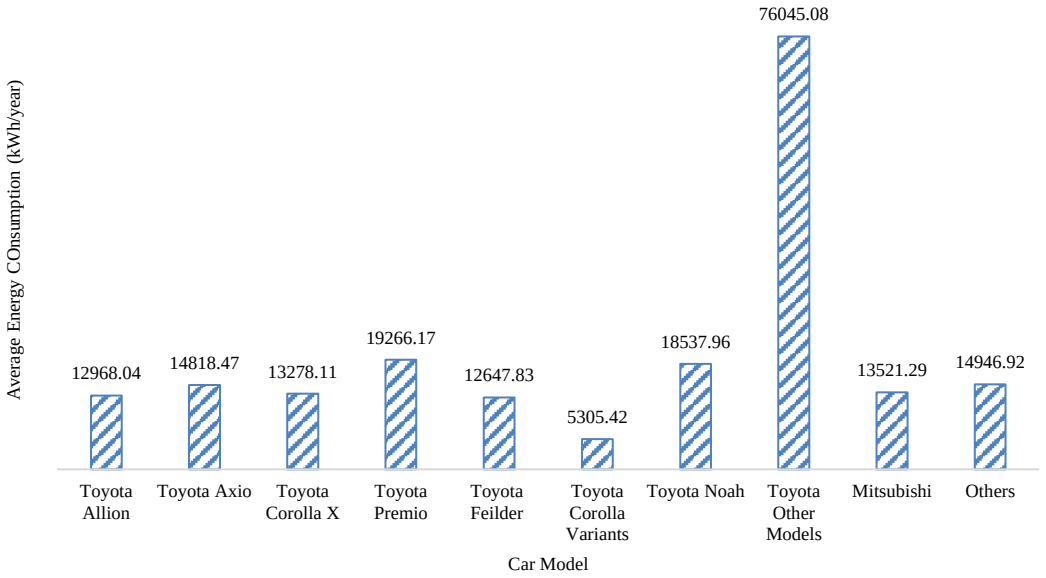

Figure 32: Average energy consumption per year versus car model (For Gasoline)

These data are solely calculated from the previous graph. Here we can also see that fewer Toyota models have higher energy consumption because they have average fuel consumption higher than anyone else. But all the other car models are following the exact same trend as the previous graph because the energy consumption is directly proportional to the fuel consumed per year.

As average fuel consumption of CNG is much higher than the gasoline over almost every manufacturing year aspects the average energy consumption of CNG is higher too. From these data, CNG has a significant amount than gasoline. At the year 1986, we have the highest energy consumption of CNG 170598.35 KWh/year. The overall energy consumption has lowered over the recent few years as modern automobile has boosted greatly.

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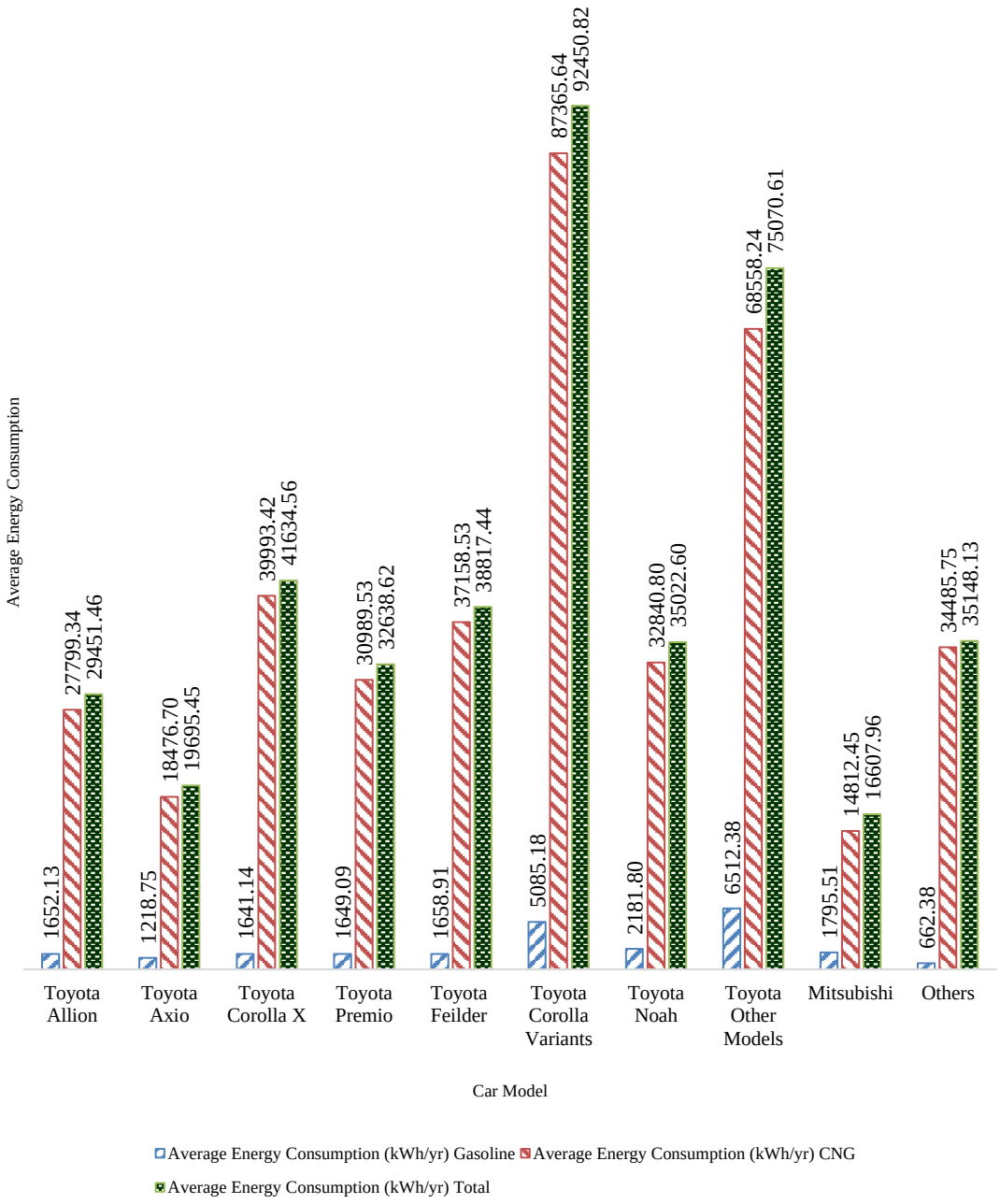

Figure 33: Average energy consumption per year versus car model (For Bi-Fuel)

As average fuel consumption of CNG is much higher than the gasoline over almost every manufacturing year aspects the average energy consumption of CNG is higher too. From these data, CNG has a significant amount than gasoline. At the year 1986, we have the highest energy consumption of CNG 170598.35 KWh/year. The overall energy consumption has lowered over the recent few years as modern automobile has boosted greatly.

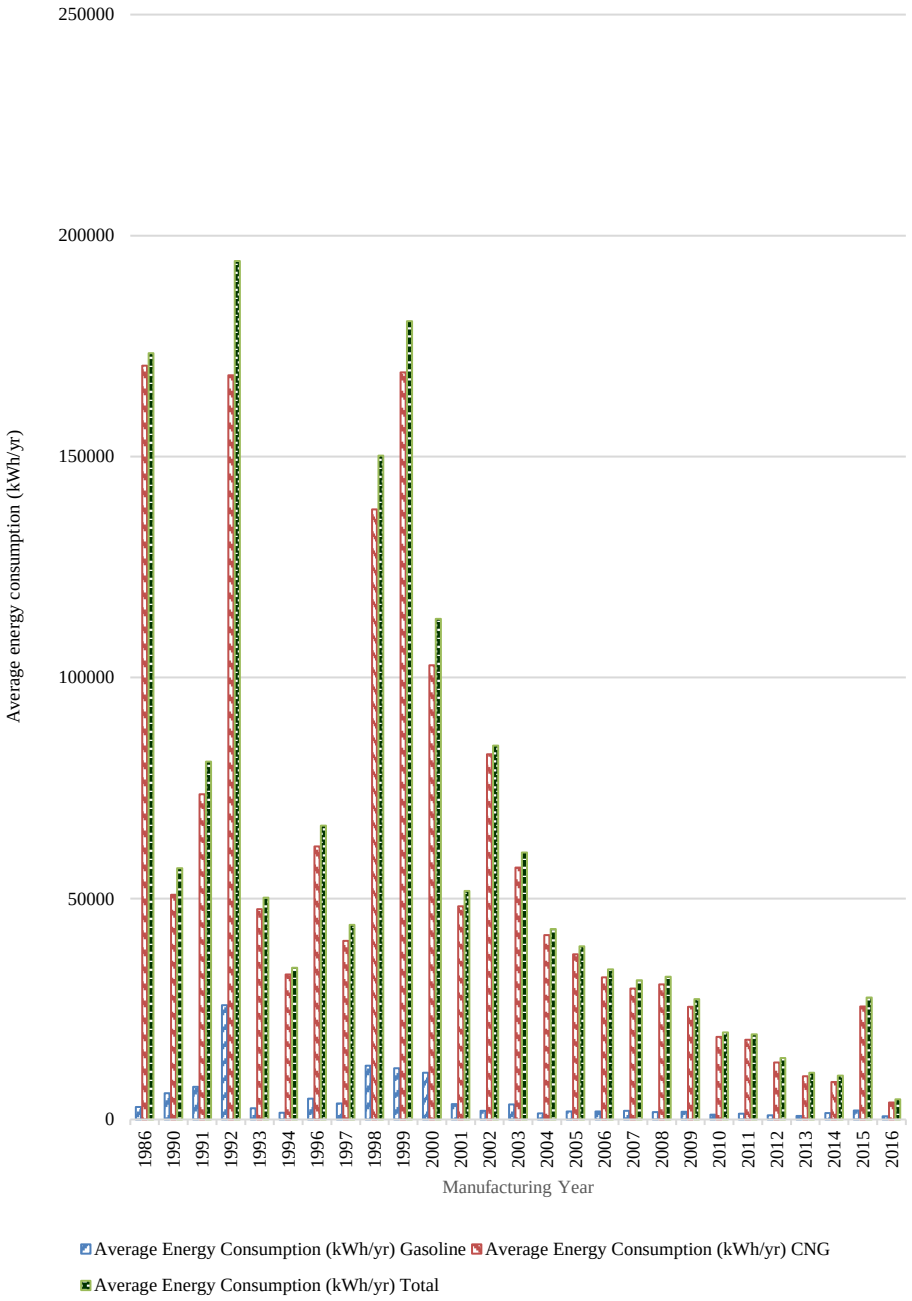

Figure 34: Average energy consumption per year versus car Manufacturing Year (For Bi-Fuel)

Here this graph shows somewhat different data compared to the previous ones. Here the energy consumption is shown both separately and combined. Here Toyota Corolla variance has higher energy consumption rate because they have a higher fuel consumption rate as observed in the previous data. The energy consumption rate due to octane is very low which is very proportional to the previous fuel consumption graph. A similar trend is followed by CNG also. These analyses also provide an insight that one liter of gasoline is very comparable do a cubic meter of CNG in Bangladesh.

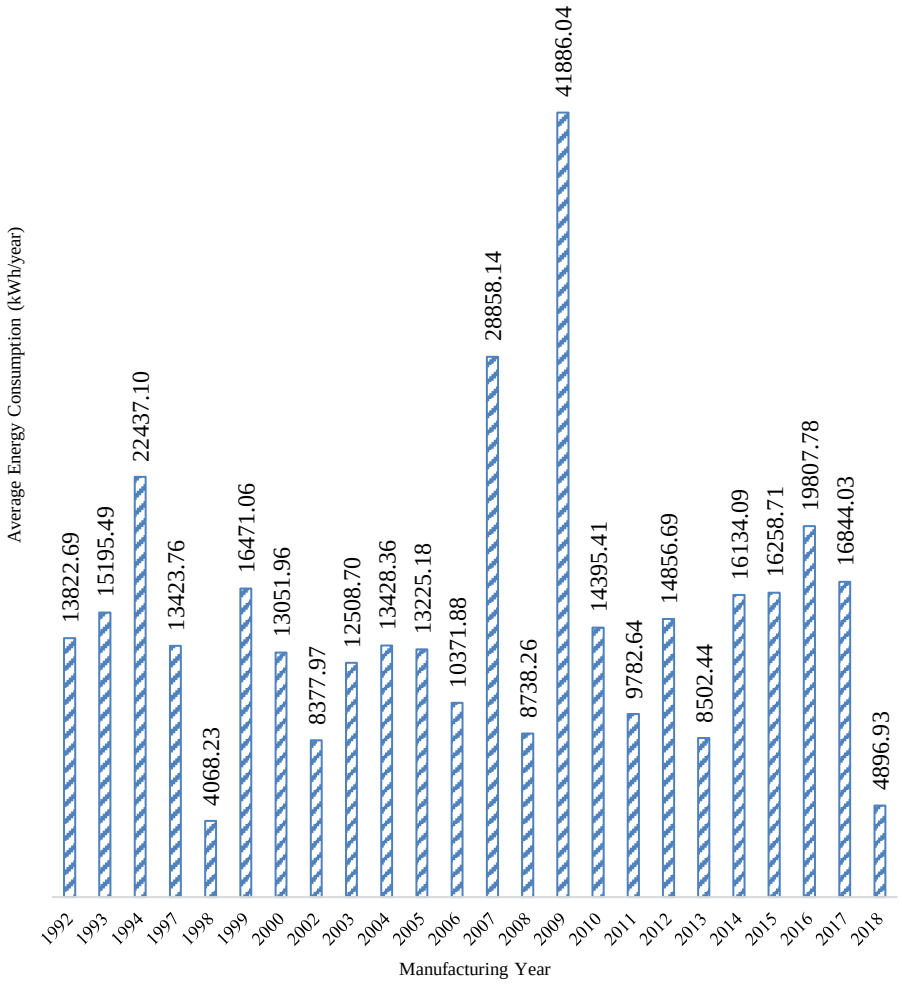

Figure 35: Average energy consumption per year versus car Manufacturing Year (For Gasoline)

The average energy consumption of cars directly depends on the amount of fuel consumed. This increases when the car is driven for huge number of kilometers and the car fuel consumption rate is high too. As for gasoline using car has highest fuel

consumption per year that's why the average energy consumption rate per year is also high. As the other manufacturing year results also reflect the same outcome. Energy consumption of gasoline is seen lower over the early 2000 years. Here the highest value 41886.04 KWh/year at the manufacturing year 2009.

4.7 Carbon Dioxide Emission

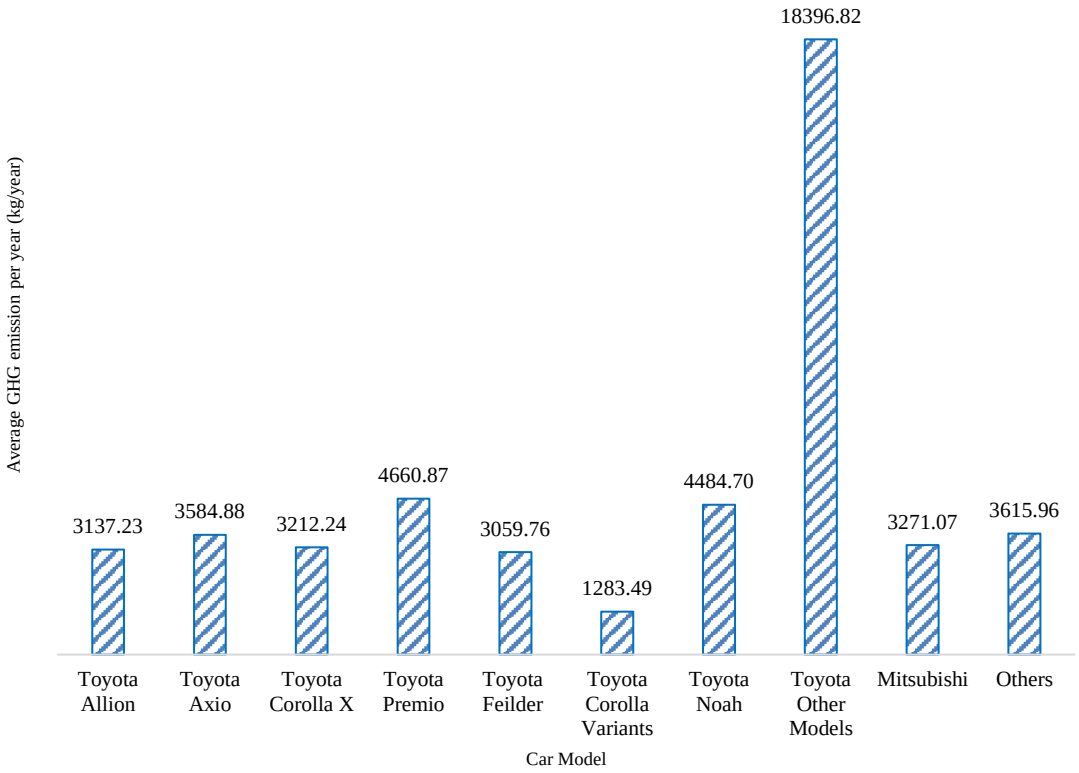

Figure 36: Average GHG emission per year versus car model (For Gasoline)

Greenhouse gas or GHG is mostly comprised of carbon dioxide. So, in this calculation, we have mostly calculated the amount of carbon dioxide that is being released by the fuel consumed by cars. And so here we can see a similar trend that is observed in the full consumed and the energy consumed per year. The more fuel is consumed, more energy is consumed, which also emits more carbon dioxide. Here also we're going to disregard the fewer Toyota variants which show unusual data.

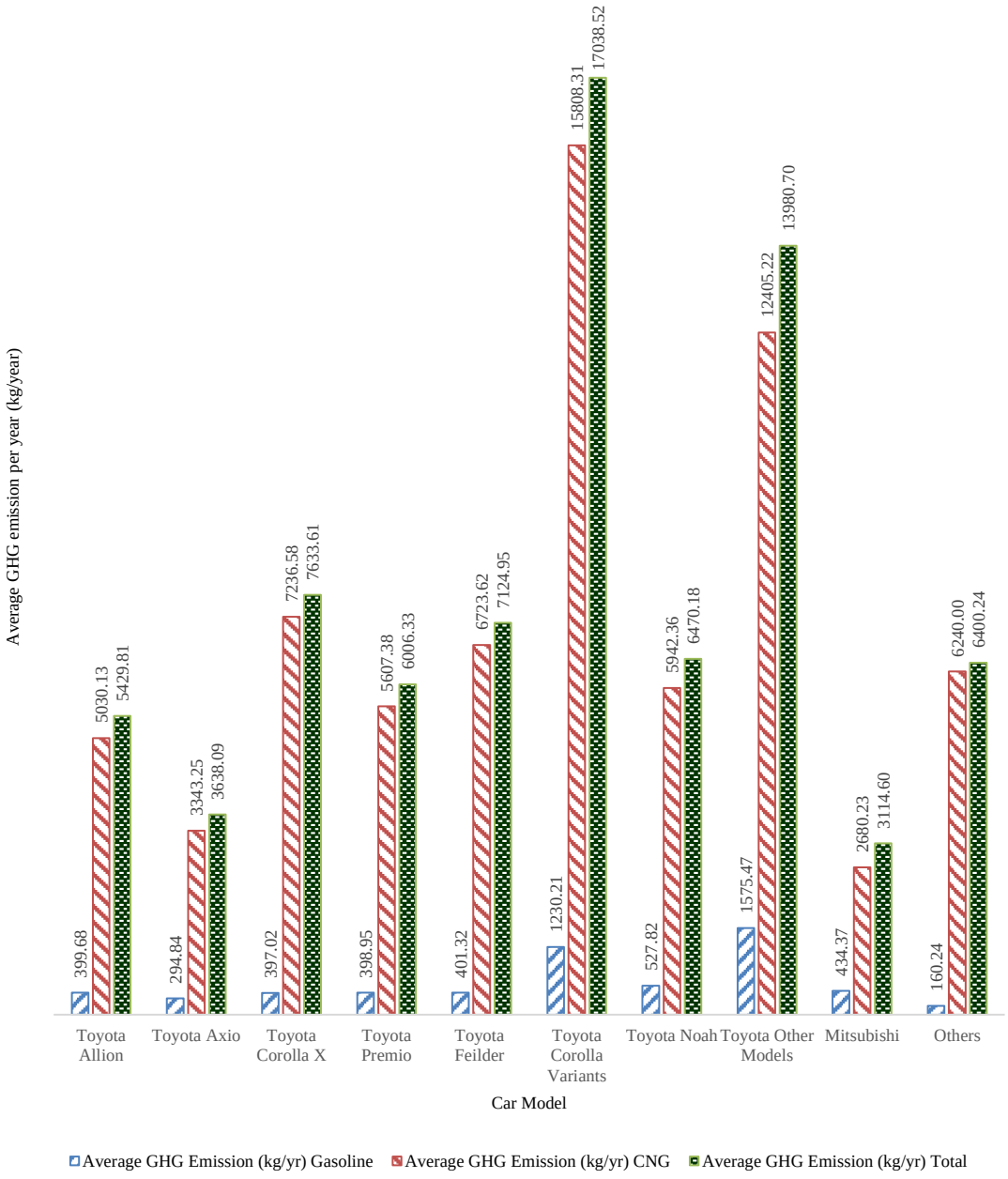

Figure 37: Average GHG emission per year versus car model (For Bi-Fuel)

The average greenhouse gas emission or carbon dioxide emission follows the same trend as energy consumption. It can be said that the emission of greenhouse gases and the amount of NRG consume is directly proportional to the fuel consumed by each vehicle. So, these data are very much comparable to previous single fuel system data which is later on discussed in the conclusion part.

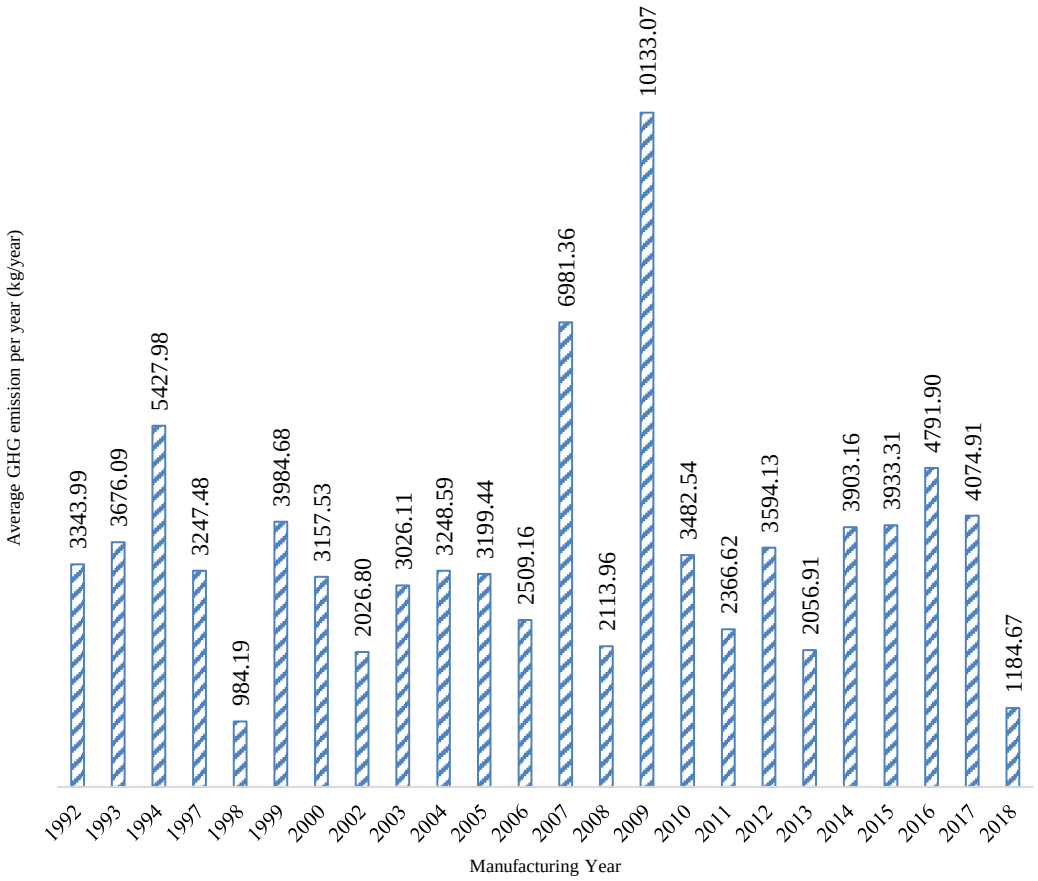

Figure 38: Average GHG emission per year versus car Manufacturing Year (For Gasoline)

Average Green House Gas (GHG) emission of the car using gasoline depends on the mileage of the car per year. The more the car runs over the year the greater the emission rate throughout the year. The manufacturing year 2009 has the highest GHG emission 10133.07 Kg/year. According to our statistical research manufacturing year 2009 has the highest amount of fuel consumption per year it has the highest GHG emission. Over the recent year we can see that this amount has a steady rate. We have lowest GHG emission over the year 1998 manufacturing year 984.19 Kg/year.

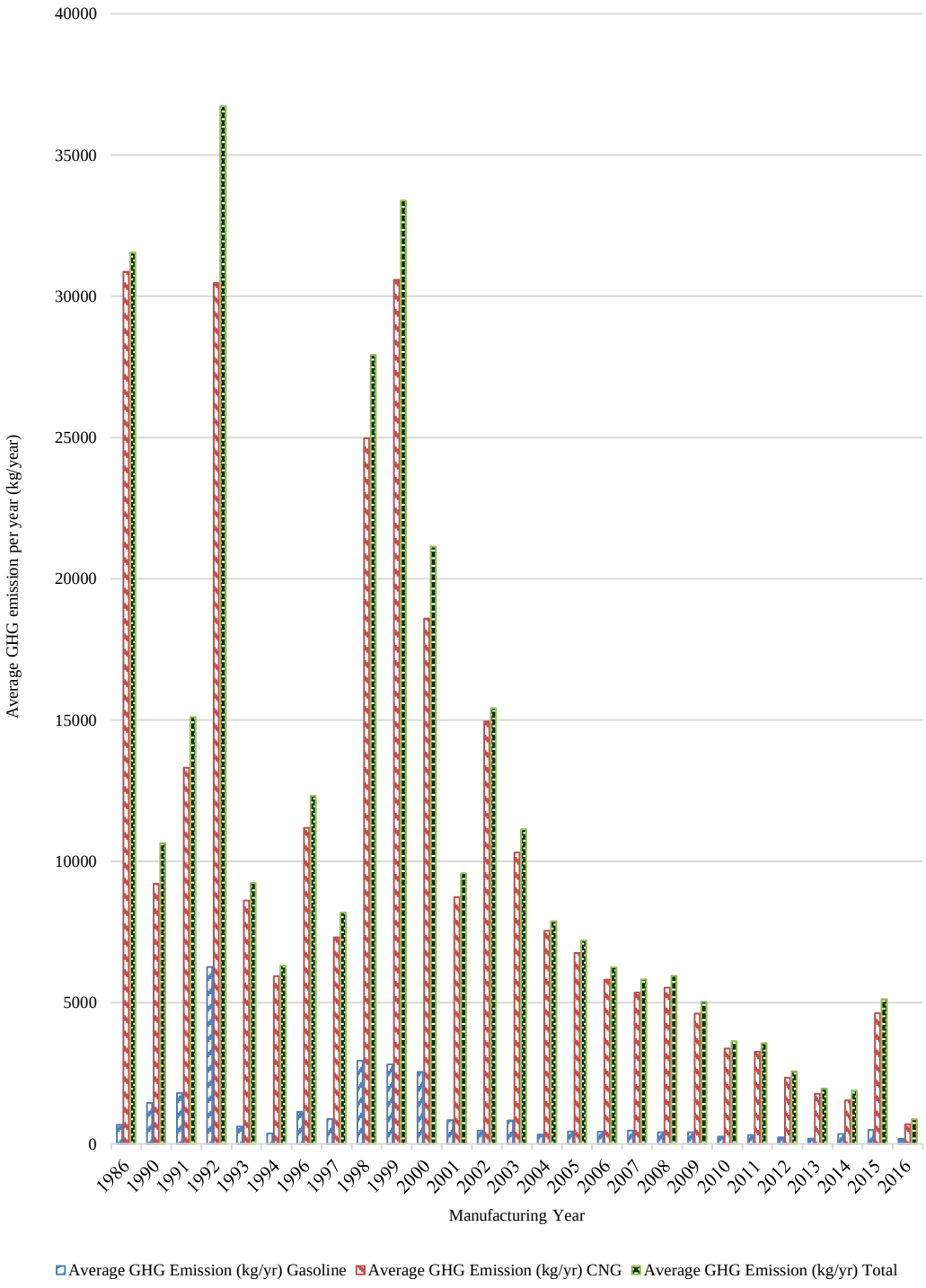

Figure 39: Average GHG emission per year versus car Manufacturing Year (For Bi-Fuel)

Average GHG emission is the outcome of the average fuel consumption rate. Though the GHG emission of gasoline is higher than the CNG for same amount of usage, the average fuel consumption of CNG is so greater than the gasoline the average GHG emission of CNG is way higher than the gasoline. Over the last few years

the total amount of GHG emission is lowering than the previous years. Cars from the manufacturing year 1992 have the highest amount of total GHG emission 36706.09 Kg/year.

4.8 Cost of Fuel

4.8.1 Fuel Cost comparison based on Car Model

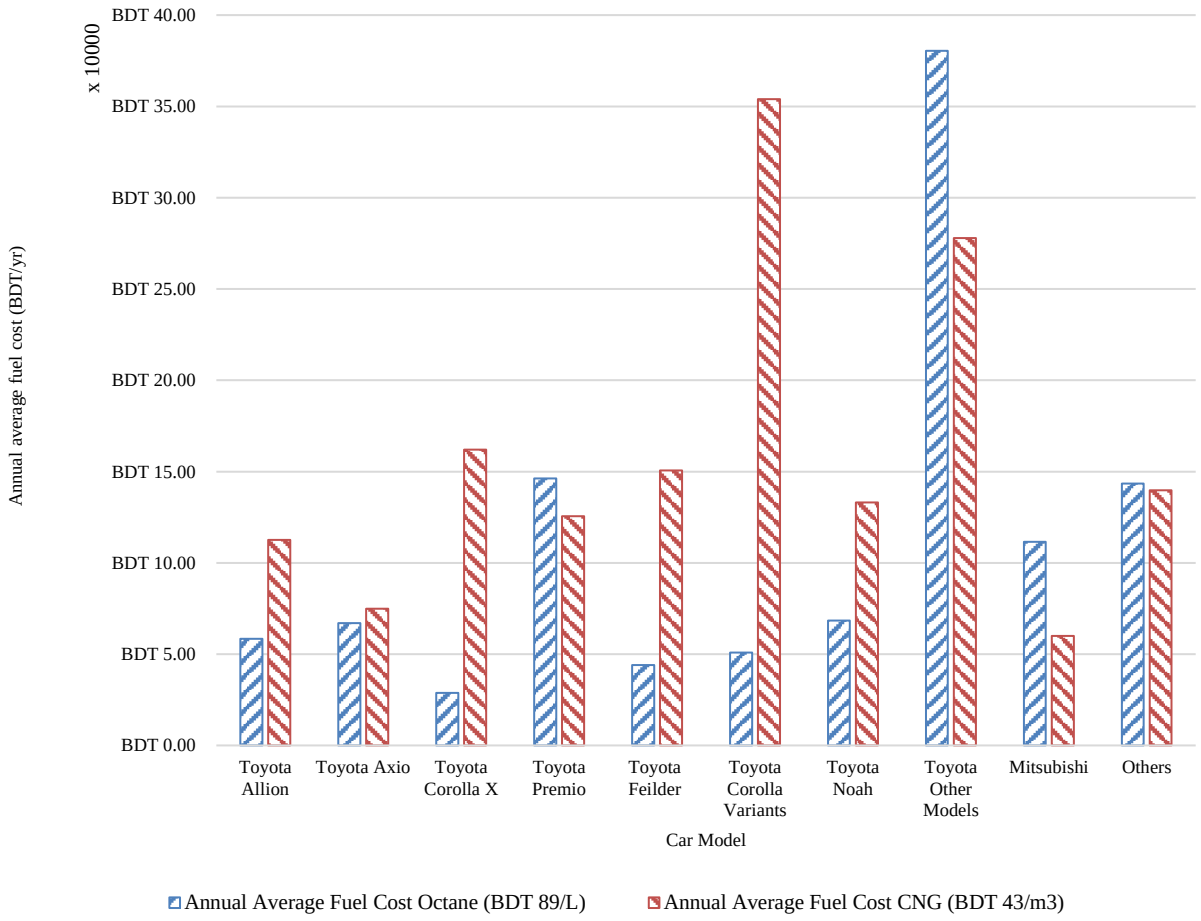

Figure 40: Average fuel cost per year based on different car models

This graph represents the annual average fuel consumption cost. Here, the highest cost for gasoline use is by Toyota's uncommon variant available in Bangladesh. For the CNG use, Toyota corolla variants have the highest cost for fuel use throughout the year, as these vehicles are usually old cars. They are converted into bi-fuel compatible

one usually more often than others. That's why they have less efficient engine causing more CNG consumption and they also run on the CNG much more than the gasoline.

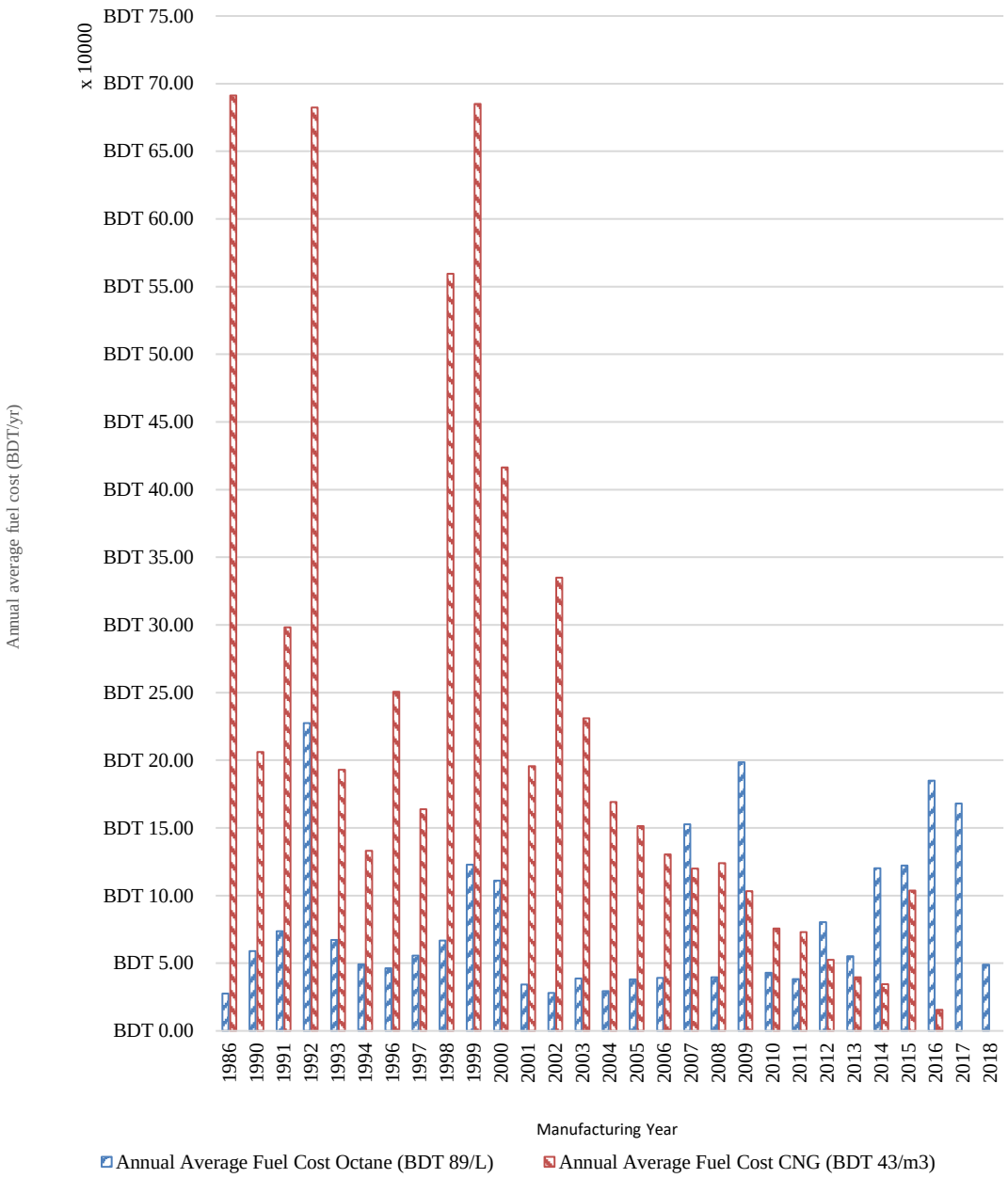

Figure 41: Average fuel cost per year based on the different manufacturing year

This graph is showing the average fuel consumption cost of gasoline and CNG for different manufacturing year vehicles. Here, before the year 2005, the cost of using CNG is very high because these older model vehicles are prone to converting and running in CNG more than the recently manufactured vehicles. The recent model ve-

hicles with latest technologies showing tendency of reduced CNG cost while high gasoline using cost as they are very likely to remain on their original gasoline engine with higher efficiency.

4.9 Comparative Analysis

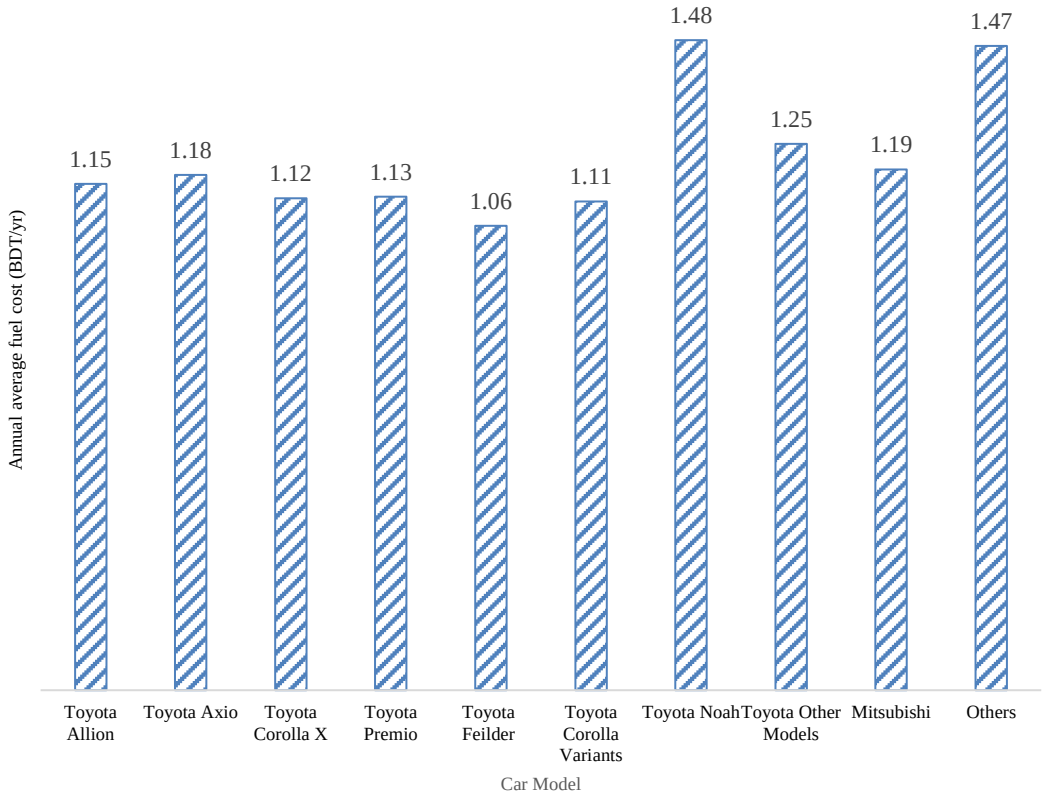

Figure 42: Energy consumption per kilometer based on different car models

Comparing the energy consumption based on different car model per unit kilometer, the result shows that Toyota Noah and other uncommon band has a higher energy consumption than Toyota usual models like Axio, Premio, etc. This graph shows how a vehicle is consuming energy per unit basis, which gives one a better concept to understand the model's performance. Here, the common models that run in Bangladesh almost have a similar pattern of energy-consuming.

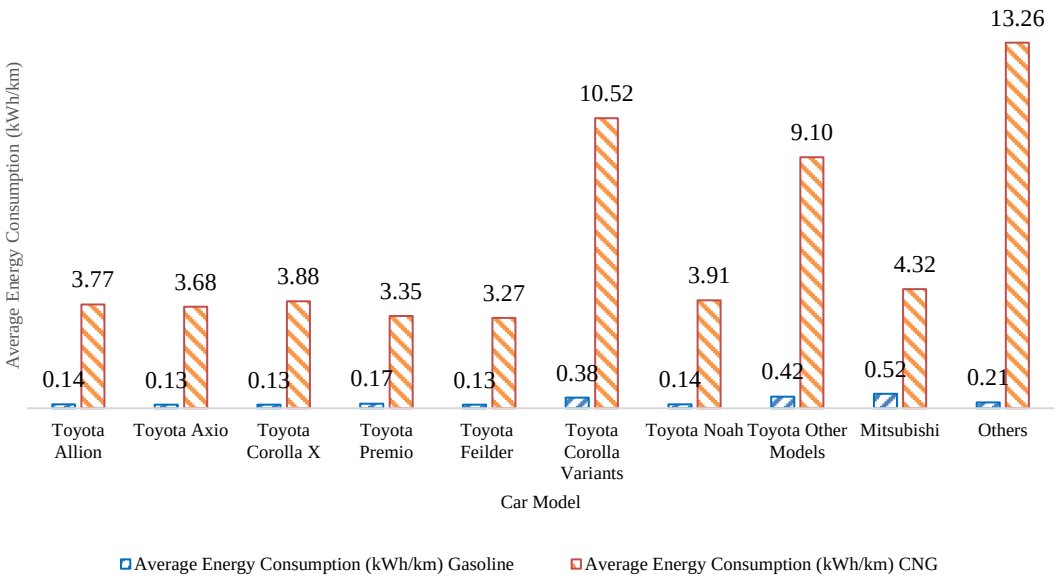

Figure 43: Energy consumption per kilometer based on the different manufacturing year

This graph shows an interesting aspect of Bangladesh's road condition. Here, the result shows that the amount of average energy consumption per kilometer of CNG is higher than the gasoline in the bi-fuel vehicle. This happens because the bi-fuel vehicle uses gasoline mainly while starting the engine and stopping the engine before reaching the destination. The vehicles most of the time run on CNG throughout the day including the idle condition on traffic where the engine runs for a significant amount of time, consuming a large amount of fuel that results in higher energy consumption than the gasoline.

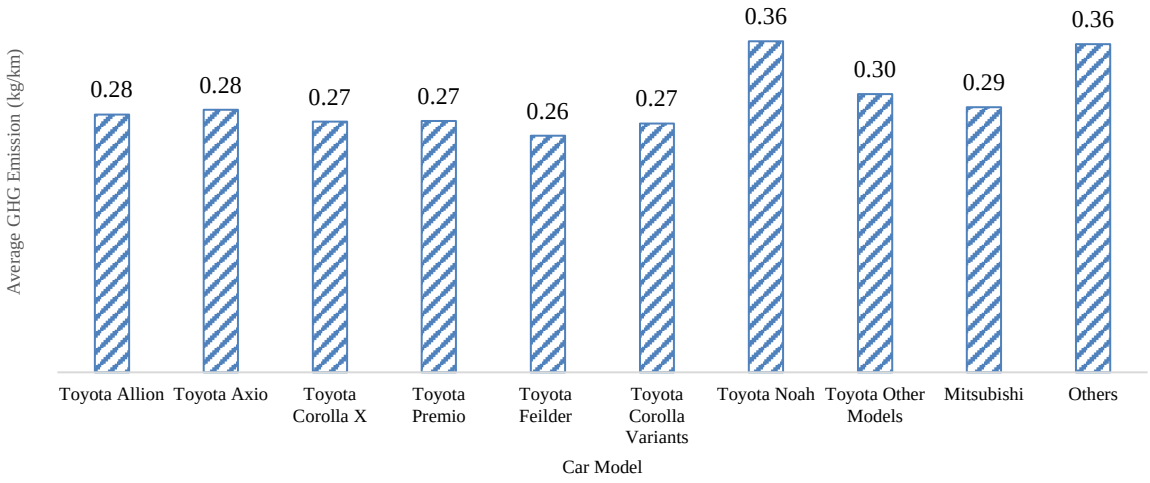

Figure 44: GHG emission per kilometer based on different car models

The average GHG emission per kilometer depends on fuel consumption mainly. This graph shows a similar output like average energy consumption per kilometer. The usual Toyota models have a similar pattern of GHG emission rate between 0.26 to 0.28 kg/km. While the other Toyota Noah, other Toyota variants and other manufacturer vehicle available in Bangladesh show a higher GHG emission rate.

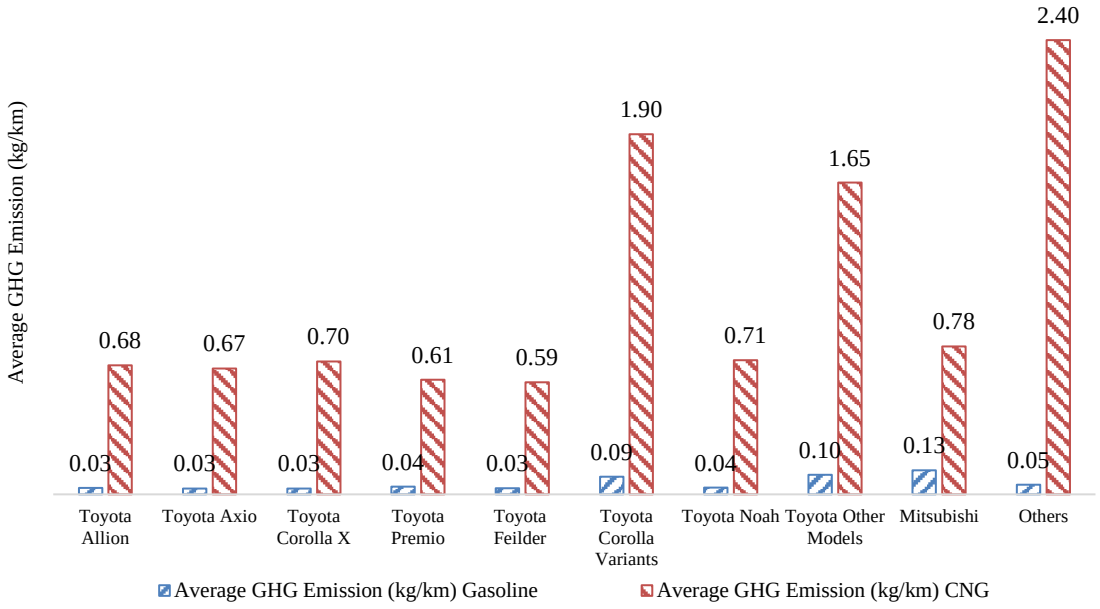

Figure 45: GHG emission per kilometer based on different manufacturing year

This graph shows the average GHG emission per kilometer for bi-fuel vehicles. The other manufacturer vehicle available in Bangladesh shows the highest amount of GHG emission for CNG while Mitsubishi shows the highest amount for gasoline. For all the vehicle models, the CNG emits a larger amount of GHG than the gasoline this is because the CNG is used at a greater amount throughout the day for any bi-fuel vehicles.

4.10 Traffic Jam Factor

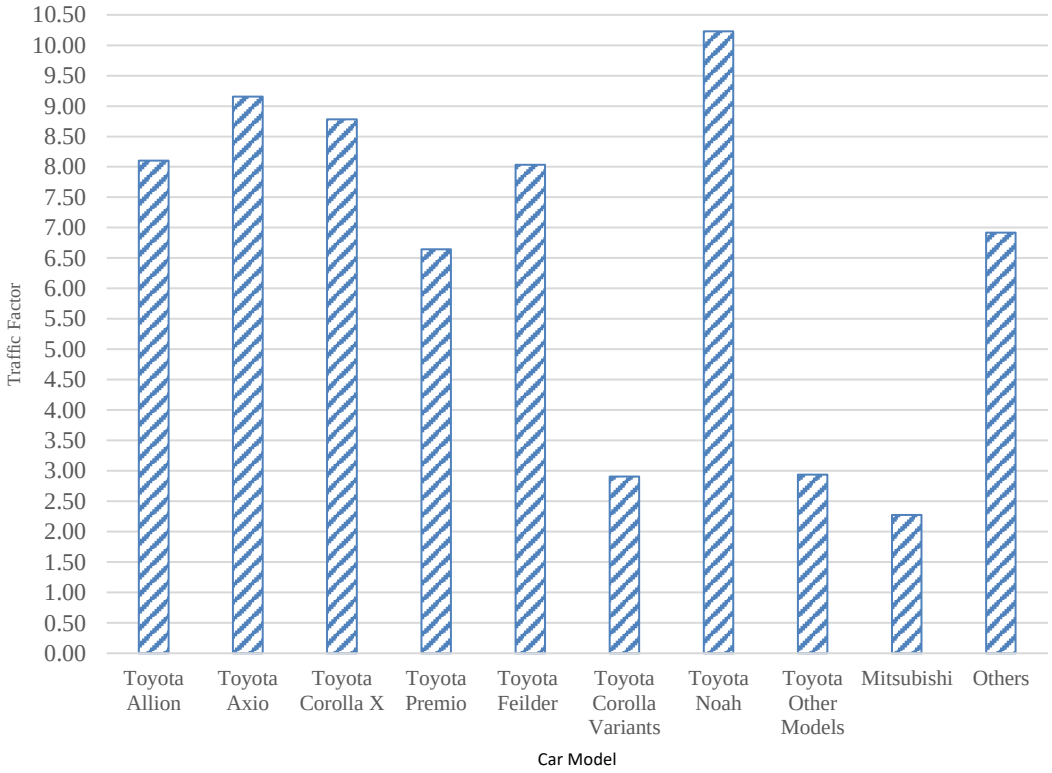

Figure 46: Traffic Jam Factor has been shown based on different car models

Traffic jam is an important factor in Dhaka city. Due to traffic jam a huge amount of energy is wasted because the drivers keep their engine running even while stuck in traffic jam. Figure 46 shows the ratio of the amount of fuel consumption for the same model of vehicle if that is run on only gasoline engine to if the vehicle is run by bi-fuel engine using gasoline. Here, it is seen that the Toyota Noah has a high ratio amount. Where common Toyota vehicles like Allion, Axio, Corolla X, Premio have almost same ration range between 7 to 9. This graph indicates that while using bi-fuel a little amount of distance is covered by using gasoline. CNG plays a major role in this situation. That's why when the same model vehicle is run only on gasoline engines it consumes about 7 to 9 times more than the bi-fuel engine running on gasoline. Due to the traffic, an enormous amount of engine running time is spent producing GHG without any use of that fuel. Using CNG in the traffic that's why increase the CNG consumption rate for any type of model that is using bi-fuel engine.

Referring back to figure 18, it can be seen that most recent year manufactured cars have less preference for converting to a bi-fuel engine. Figure 9 shows that recent

engines have higher efficiency and prone to consume less fuel, less energy (shown in figure 34), and emit less carbon dioxide or GHG (figure 39). These show that the recent manufacturing year of the engine is, the more it is likely to perform with superior efficiency.

Chapter 5 Conclusion and Recommendation

5.1 Conclusion

This whole study provides a constructive scenario of the current condition of private cars' pattern fuel consumption, energy consumption, and GHG emission rate. Through various graphs obtain from calculating the research data, based on the manufacturing year and different cars model the current situation is shown along with proper discussion mentioning the reasons behind them. For the policymakers of Bangladesh, this study will provide a better understanding of these phenomena. As the environment of Dhaka is getting polluted at a very alarming rate, pollution caused by private vehicles is one of the major reasons among them. That's why, by understanding the pattern of GHG emission, proper decisions could be taken for a better future.

From this research, it is extrapolated that, annually 275,127,837 liters of Gasoline, 643,868,507 m^3 of CNG and 9,520,310,162 kWh of energy is being consumed while 1,960,922 metric tons of GHG is being emitted from the streets of Bangladesh from private cars alone. Unless certain measures are taken, these numbers will go up and will impact greatly on both economy and environment.

5.2 Research Limitation

This research was quite an unorthodox subject to work with but was very important for the current situation of air pollution by private vehicles in Dhaka city. For having a better understanding of the working procedure to carry on this research, there was limitation of previously published literature available.

Selecting the questionnaires for collecting the data was a challenging task. As in a limited question number, all the necessary data had to be extracted. The questions had to be easy enough so that the responders will easily understand the questions to provide adequate answers to them.

While collecting the data using google form through different online social media platforms, less attention towards answering the questions was shown among the people. Awareness among the mass people about this type of survey is quite less, that effects the rate of data collection through online social media platforms. The proper response from social media would have reduced the time for approaching the targeted sample size.

Collecting the data from different areas of Dhaka, from person to person who owns any type of private car shows newer complications. As many drivers were not the owner of that vehicle, they were not able to answer all the questions properly. So, these unfinished sets of data had to be neglected, resulting in more effort for fulfilling the targeted sample size number.

Throughout the calculation, different obstacles appeared. To be able to show proper graphical presentation of the data that were collected was challenging too.

5.3 Recommendation

By observing the results, to reduce the amount of GHG emission many steps could be taken for a safer environment in the upcoming future generation. Among the many causes that increase the amount of GHG emission, older private cars specifically those manufactured before the year 2000 are one of the major ones. With less efficient engines that consume a huge amount of fuel resulting in a greater amount of GHG emission than the recent manufacturing cars regardless of any manufacturing companies. That’s why restricting the older and obsolete vehicles from streets will result in decreasing GHG emissions.

In Bangladesh, a huge number of private vehicles are reconditioned. These vehicles are not efficient for a lower fuel consumption rate. Over the years this type of vehicle loses its efficiency more and more. That’s why when they run on the road for a longer period of time, they start to produce more and more GHG. To prevent this problem, reconditioned vehicles have to be reduced. Awareness has to be made for this type of policy change. Subsidy or reducing tax from buying newer model vehicles have to be

patronized. These newer model vehicles with improved efficiency will result in lesser GHG emissions.

The number of hybrid cars in Bangladesh is still low. Hybrid cars have higher efficient engines than conventional ones, resulting in significantly lower GHG emissions. A proper public awareness must be increased about using hybrid vehicles rather than conventional ones. Policymakers have to ensure necessary steps so that the people can buy hybrid vehicles in a simpler way at a lower cost. Plug-in hybrid vehicles are very much suitable for the condition of Dhaka city having an alarming amount of traffic. Though external power sources have to be built for powering these vehicles. But in the long run, hybrid and plug-in hybrid vehicles will show the tendency of decreasing GHG emissions from vehicles.

5.4 Suggestion for Future Work

There is various types of vehicles running around Dhaka city. Among them as the number of private passenger vehicles is significant, this research was done only based on them. But, to have a total picture of the energy consumption and GHG emission of the vehicles other types of vehicles have to be taken under consideration.

For the future, working with other vehicles like buses, trucks, cargo vans may impale newer problems like lack of data for actual output. As many local buses don't have any working dashboard, so they will not be able to provide information like current mileage, fuel consumption rate, etc. properly. To collect information from these types of vehicles will be a challenging one too. The bus or truck drivers are not usually literate enough to understand the significance of the questions that have to be asked.

Vehicles like a motorcycle, on the other hand, has a higher number than private car available in Bangladesh. That's why a large number of sample size will be needed. Collecting data from the motorcycles can be challenging too, as usually the driver of any parked motorcycle is tough to find nearby.

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APPENDIX

Letter of Permission to Collect Vehicle Data for Research Purposes

الجامعة الإسلامية للتكنولوجيا
UNIVERSITE ISLAMIQUE DE TECHNOLOGIE
ISLAMIC UNIVERSITY OF TECHNOLOGY
DHAKA, BANGLADESH
ORGANISATION OF ISLAMIC COOPERATION

15 November 2018

TO WHOM IT MAY CONCERN

Under the supervision of Dr. Mohammad Ahsan Habib, the students namely Muhammad Mahmood Hasan (Student ID: 151430), Md. Ehsanul Haque (Student ID: 151439) and Mohammad Tosif Nur Zahin (Student ID: 151442) of the Department of Mechanical and Chemical Engineering of Islamic University of Technology are conducting a research work on "IMPACT OF ENERGY CONSUMPTION OF CONVENTIONAL AND HYBRID VEHICLE IN BANGLADESH". In this research they need to collect some data regarding the distance travelled per year, fuel consumption, preference of fuel and driving experience of different vehicles running in the streets and highways of Bangladesh. Your co-operation to those students will be highly appreciated.

যাদের জন্য প্রযোজ্য

ড. মোহাম্মাদ আহসান হাবিবের তত্ত্বাবধানে ইসলামিক ইউনিভার্সিটি অফ টেকনোলজির মেকানিক্যাল ও কেমিক্যাল ইঞ্জিনিয়ারিং বিভাগের ছাত্র মুহাম্মাদ মাহমুদ হাসান (স্টুডেন্ট আইডিঃ ১৫১৪৩০), মোঃ এহসানুল হক (স্টুডেন্ট আইডিঃ ১৫১৪৩৯) এবং মোহাম্মদ তৌসিফ নূর জাহিন (স্টুডেন্ট আইডিঃ ১৫১৪৪২) "IMPACT OF ENERGY CONSUMPTION OF CONVENTIONAL AND HYBRID VEHICLE IN BANGLADESH" শীর্ষক একটি গবেষণা করছে। এই গবেষণায় তাদের বাংলাদেশের বিভিন্ন সড়কে ও মহাসড়কে চলমান যানবাহন সম্পর্কিত কিছু তথ্য উপাত্ত প্রয়োজন। যেমন: প্রতি বছর যানবাহনের অতিক্রান্ত দূরত্ব, যানবাহনের জ্বালানি ব্যয়ের হার, চালকের জ্বালানি ব্যবহারের ওপর স্বাচ্ছন্দ্য ও অভিজ্ঞতা। এ ব্যাপারে আপনার সহযোগিতা একান্ত কাম্য।

Dhaka 15/11/2018

Dr. Mohammad Ahsan Habib
Associate Professor
Department of Mechanical and Chemical Engineering
Islamic University of Technology (IUT)
Board Bazar, Gazipur, Bangladesh-1704
Email:mahabib@iut-dhaka.edu

Dept. of Mech. & Chem. Engg. DHAKA. IUT

BOARD BAZAR, GAZIPUR-1704, BANGLADESH
Tel : 9291250, 9291252 PABX : 9291254-59 Fax : 880-2-9291260 e-mail : vc@iut-dhaka.edu website : www.iutoic-dhaka.edu

Survey Questions Asked for The Collection of Data

People were provided with the link (https://forms.gle/oT5ZF3V1SFMSmxuN7) and after they clicked on it, the link directed them to this form where the landing page looked like this.

আপনার ব্যবহৃত গাড়ি এবং এর জ্বালানি বিষয়ক কিছু তথ্য দিয়ে সাহায্য করবেন কি?

আসসালামু আলাইকুম।
আমরা, Islamic University of Technology (IUT) এর মেকানিক্যাল এবং কেমিক্যাল ইঞ্জিনিয়ারিং বিভাগের চতুর্থবর্ষের ৩ জন ছাত্র, বাংলাদেশে ব্যবহৃত যানবাহন এবং জ্বালানি নিয়ে ড. আহসান হাবিব স্যারের তত্ত্বাবধানে একটি গবেষনা করছি। এই জরিপে আপনার প্রদানকৃত তথ্যসমূহ যথাযথ গোপনীয়তা বজায় রেখে শুধুমাত্র আমাদের এই গবেষনার কাজে ব্যবহৃত হবে। আমাদের জরিপে অংশ নেয়ার জন্য আপনাকে ধন্যবাদ।

ধন্যবাদন্তে,
মুহাম্মাদ মাহমুদ হাসান
মোঃ এহসানুল হক
মোহাম্মদ তৌসিফ নূর জাহিন

*Required

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Figure 47: Landing page of the survey

The first-page ques were as following:

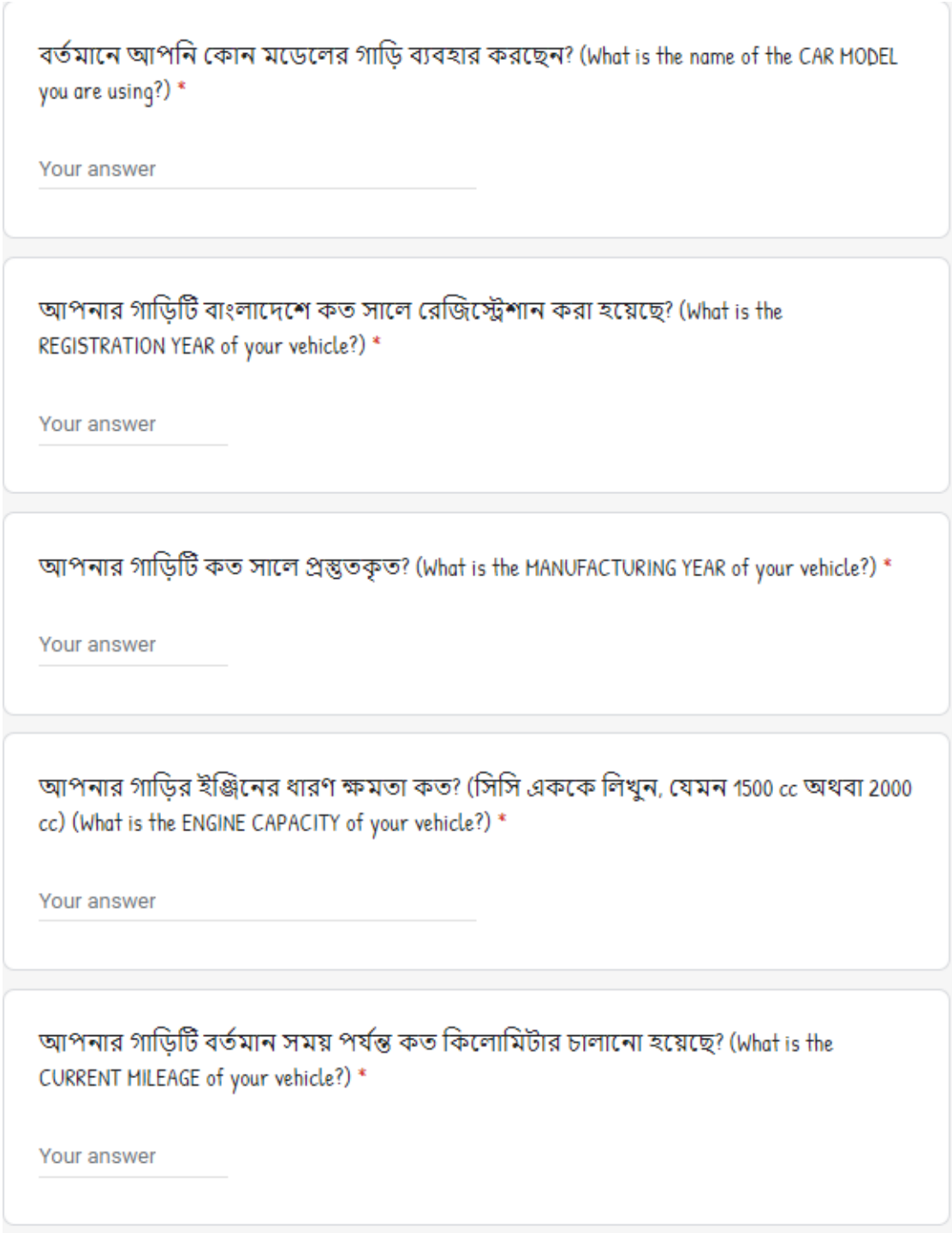


Figure 48: Landing page questions regarding general data (Part 1)

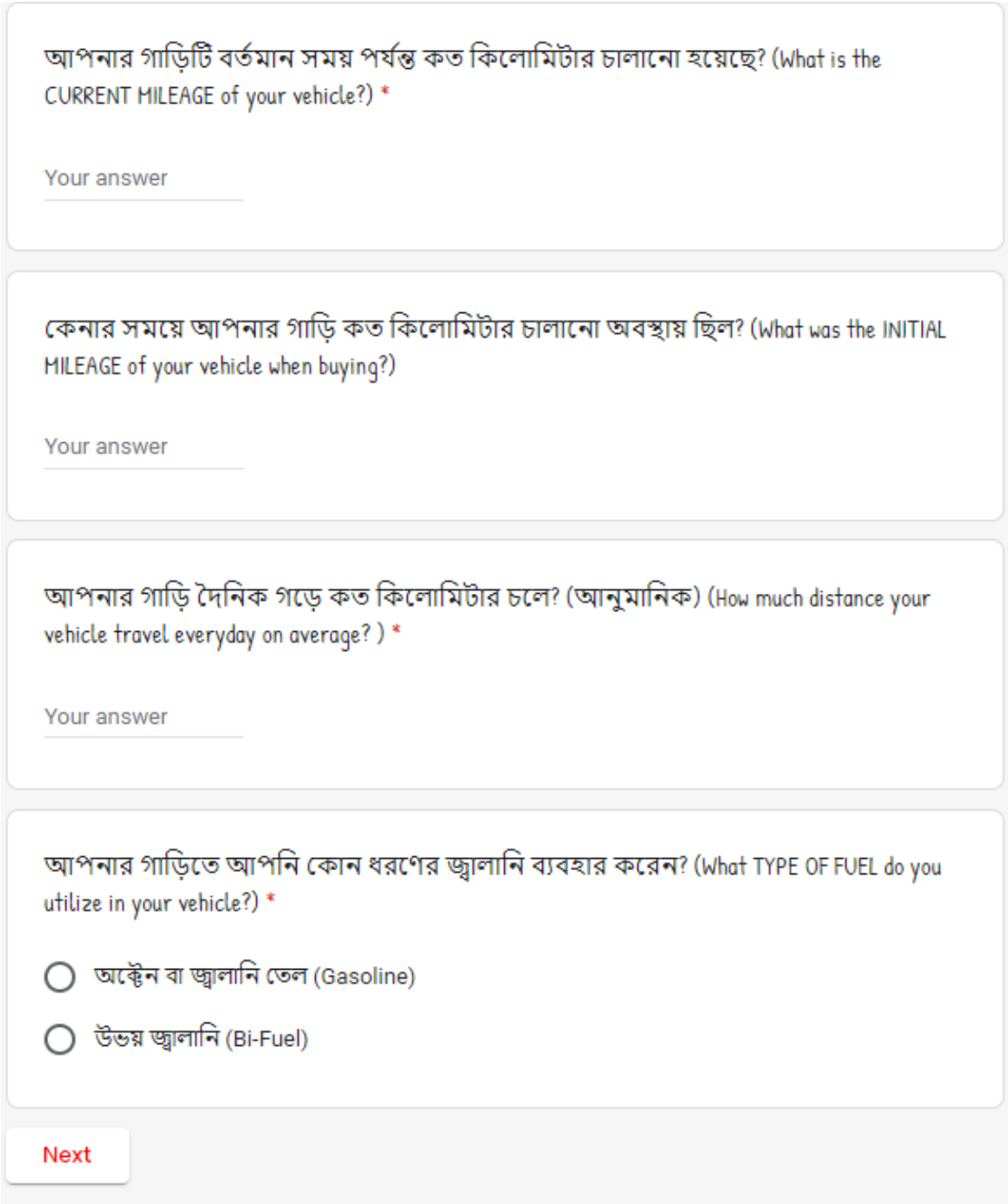


Figure 49:Landing page questions regarding general data (Part 2)

Here, two choices are available for fuel preference and each choice directly to the page that is dissimilar from the pages that the other choices lead towards. The different pages are given below.

If option 1 or Gasoline is chosen:

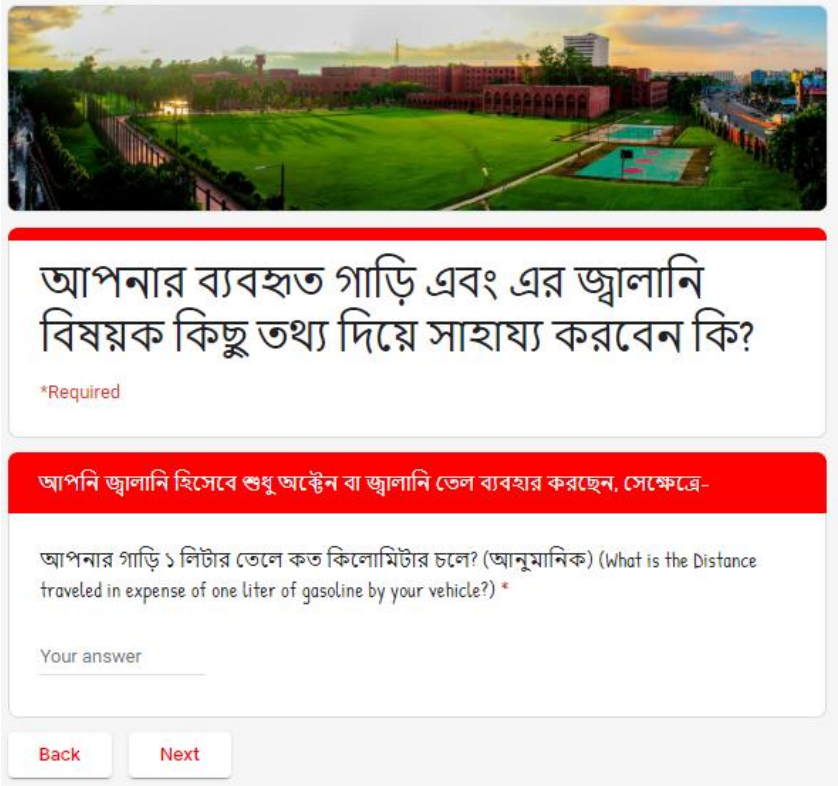


Figure 50: Second Page if Gasoline is the chosen option

After this, the next page is the final page.

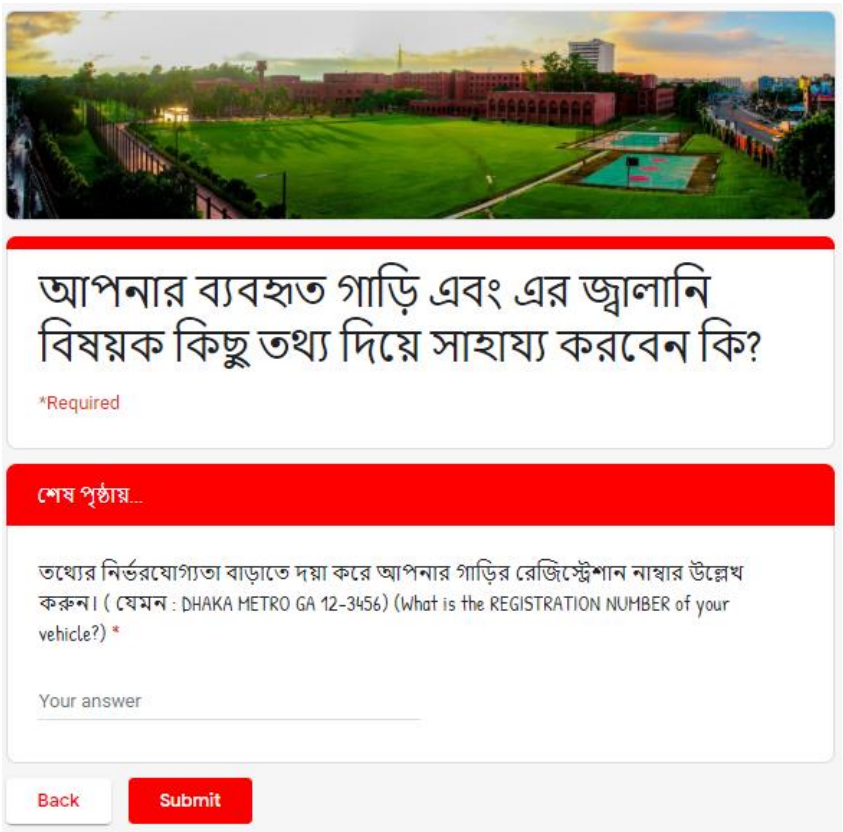


Figure 51: Final page containing the crucial element for validating the data

But after figure 3, if option 2 or Bi-fuel is chosen as fuel preference, this leads to the following page

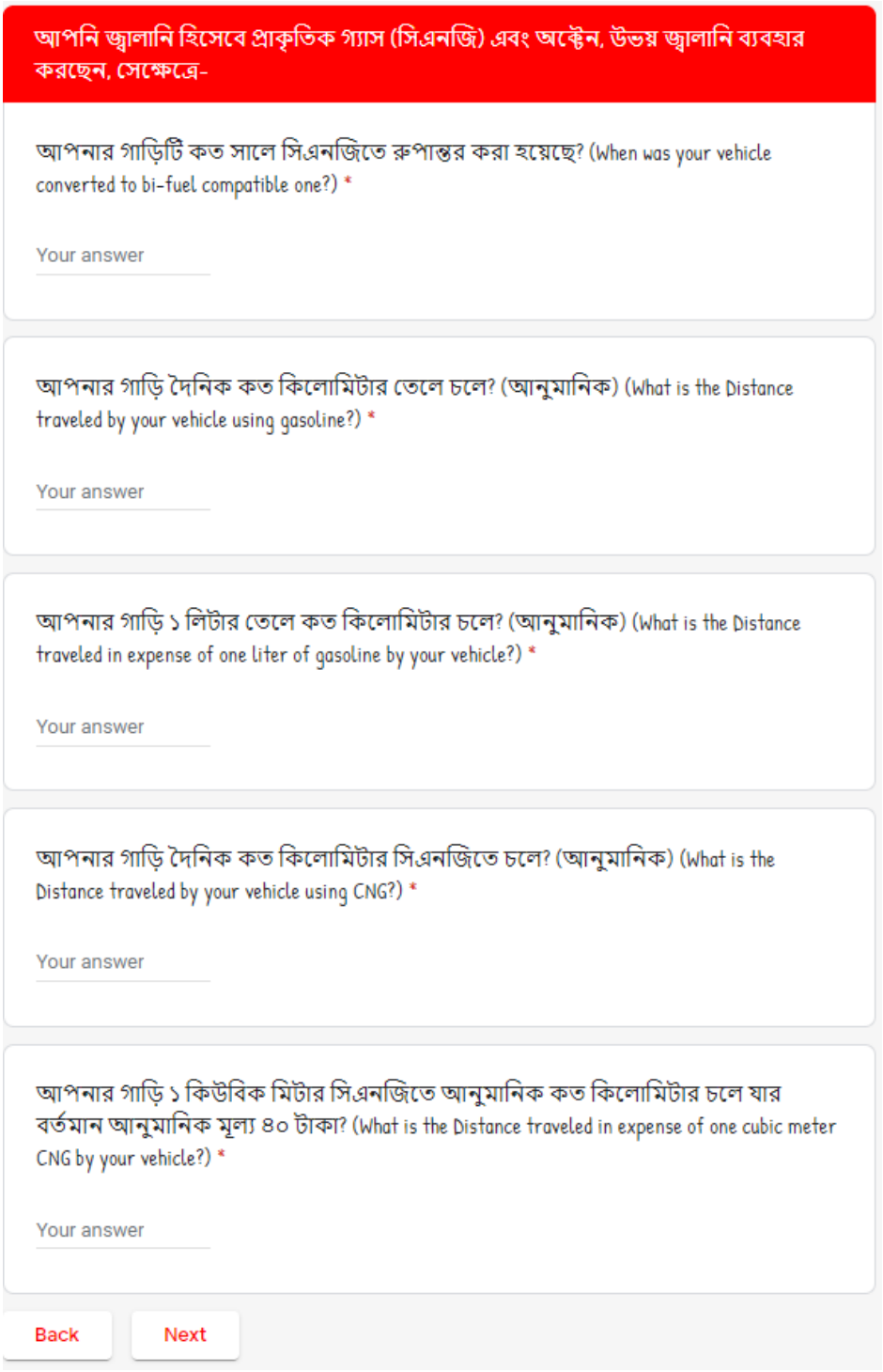


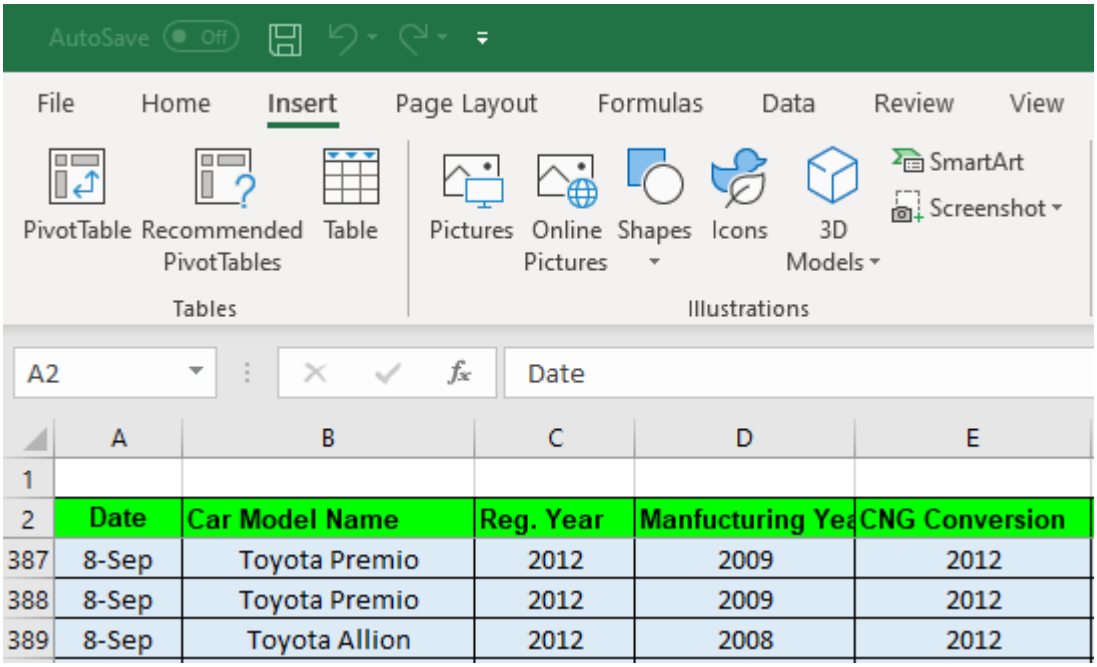
Figure 52: Second Page if Bi-Fuel is the chosen option

After this figure, 5 pages is shown. Thus, the survey concludes.

EXCEL Spreadsheet User manual

Step 1: Creating a Data Overview

After conditioning all the data in an Excel file, the files were sorted according to their date when the data was collected. After sorting out all the data, pivot table function is used to generate sub-tables from this data.



	A	B	C	D	E
1					
2	Date	Car Model Name	Reg. Year	Manfucturing Yea	CNG Conversion
387	8-Sep	Toyota Premio	2012	2009	2012
388	8-Sep	Toyota Premio	2012	2009	2012
389	8-Sep	Toyota Allion	2012	2008	2012

Figure 53: Pivot Table feature in Insert option of Microsoft Excel

At first, a table is created depicting how much data were collected each day. This results in the idea table.

Similarly, more data tables are created projecting various criteria such as engine models, car models, manufacturing year, registration year, CNG conversion year, fuel type, etc.

Step 2: Calculating necessary parameters on a separate file

L	M	N	O	P
Mileage (km)	Mileage Per Year (km/yr)	Average FC per year(L/yr)	Energy Consumption (kWh/yr)	GHG Emission(kg)
9000	3000	300	2675.00001	647.136
27000	2700	225	2006.250008	485.352
2000	666.6666667	88.88888889	792.5925956	191.744
1000	1000	250	2229.166675	539.28
55000	11000	1466.666667	13077.77783	3163.776

Figure 54: Parameters calculated according to equations (for gasoline)

After the graphs have been generated based on these tables (as shown in the results chapter), a separate file is created from the overview.

In this separate file, the data will be reorganized based on fuel preferences. The fuel preferences such as gasoline or octane will be taken to a separate file and both fuel references data will be taken to another file. Now the subsection that contains the gasoline data will be used calculate average fuel consumption, average energy consumption, and average GHG emission per year according to the equations provided in the calculations. At first mileage was calculated by subtracting initial mileage from total mileage. Then mileage per year was calculated by dividing the net mileage with the subtraction of registration year from 2019. From this we calculated our desired parameters.

The subsection containing both fuel preference data is calculated differently. Here we need to consider, both the time before and after the conversion to CNG. Before the conversion to CNG, the car was running on octane and after the conversion only partially the car ran on octane. For calculation we first obtain net mileage and mileage per year as we have obtained in the previous subsection. Here we have considered that, before the conversion to CNG, the consumption rate of primary fuel, in this case gasoline, was same as it is at the time of data collected. Dividing the mileage per year with this consumption rate yields the data of amount of gasoline consumed per year before the conversion.

		For Oil							For CNG			
Mileage [km]	Mileage Per Year [km/	Mileage by Oil, Pre Conv.[L/y	Oil Mileage pre-conversion [km/	Mileage by Oil, Pro Conv.[L/y	Total Oil Consumption	Average FC per year[L/y	Energy Consumption [kWh/	GHG Emission[kg]	Mileage by CNG [km/y	Average FC per year[m3/	Energy Consumption [kWh/	GHG Emission[kg]
135000	10384.61538	1483.516484	1730.769231	247.2527473	2472.527473	247.2527473	2204.670338	533.3538462	13500	1928.571429	20464.07143	3702.857143
47000	3615.384615	451.9230769	124.6684358	15.58355438	592.1750663	59.21750663	528.0227694	127.7392679	10966.66667	1566.666667	16623.9	3008
104000	5777.777778	825.3968254	385.1851852	55.02645503	2311.111111	165.0793651	1471.957677	356.096	16250	2166.666667	22990.5	4160
307815	21986.78571	2198.678571	5863.142857	586.3142857	6443.457143	586.3142857	5227.963067	1264.750272	46172.25	7695.375	81655.62413	14775.12
31000	7750	775	3875	387.5	1162.5	387.5	3455.208346	835.884	19800	2066.666667	21929.4	3968
104000	14857.14286	1485.714286	990.4761905	99.04761905	198.0952381	99.04761905	883.1746065	213.6576	10400	1300	13794.3	2496
177000	8045.454545	804.5454545	277.4294671	27.74294671	5132.445141	301.9085377	2692.070805	651.2529443	41300	5900	62604.9	11328
163243	10882.86667	1554.695238	375.2712644	53.61018062	2198.017406	169.078262	1507.614508	364.7221005	21765.73333	2720.716667	28869.52455	5223.776

Figure 55: Parameters calculated according to equations (for Bi-fuel)

To calculate the amount consumed after the conversion is tricky. At first, we calculate the amount of mileage contributed by running on gasoline. To do that we calculate the percentage of average daily run buy gasoline and multiply it with the mileage per year. This gives us the amount of mileage contributed buy gasoline. Now similarly we divide this mileage per year with the fuel consumption rate and achieve the amount of gasoline consumed after the conversion of CNG, per year. Now we multiply the amount of gasoline consumed before the conversion with the subtraction of

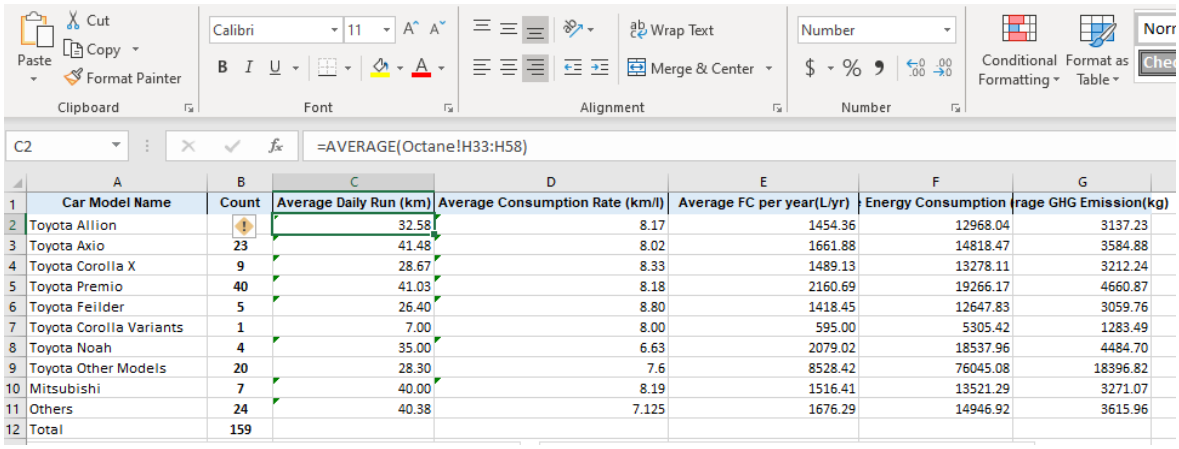
registration year from the CNG conversion year. We then multiply the amount of gasoline consumed after the conversion with this abstraction of the subtraction of the CNG conversion year from 2019. (This is due to the fact that before the conversion of CNG, from the registration year of the car up until the year the car was converted, it utilized gasoline as its primary fuel which is why gasoline consumed per year during this time was multiplied with this amount of time. After the conversion, the partial amount was calculated by multiplying the weighted amount that was yielded from the average daily run on gasoline. This amount was multiplied with the time from CNG conversion year up until 2019)

Step 3: Create a comparison table based on Car Model

Here the car models we're subdivided based on popular recurrence. The number of cars belonging to that section is calculated. Here, two subsections of the file are created. The first one contains the data of gasoline. Here the average value of daily run, consumption rate, energy consumption, GHG emission for every car model is calculated.

In the other section, a similar type of table is created but comprises of dual-fuel data. Here the average calculation for all the parameters was done but gasoline and CNG are separately calculated.

A similar file is created where the comparison table is based on the car manufacturing year.



	A	B	C	D	E	F	G
1	Car Model Name	Count	Average Daily Run (km)	Average Consumption Rate (km/l)	Average FC per year(L/yr)	Energy Consumption	rage GHG Emission(kg)
2	Toyota Allion		32.58	8.17	1454.36	12968.04	3137.23
3	Toyota Axio	23	41.48	8.02	1661.88	14818.47	3584.88
4	Toyota Corolla X	9	28.67	8.33	1489.13	13278.11	3212.24
5	Toyota Premio	40	41.03	8.18	2160.69	19266.17	4660.87
6	Toyota Feilder	5	26.40	8.80	1418.45	12647.83	3059.76
7	Toyota Corolla Variants	1	7.00	8.00	595.00	5305.42	1283.49
8	Toyota Noah	4	35.00	6.63	2079.02	18537.96	4484.70
9	Toyota Other Models	20	28.30	7.6	8528.42	76045.08	18396.82
10	Mitsubishi	7	40.00	8.19	1516.41	13521.29	3271.07
11	Others	24	40.38	7.125	1676.29	14946.92	3615.96
12	Total	159					

Figure 56: Parameters are catalogued based on Car Model (for gasoline)

K5 =I5+J5

Car Model Name	Count	Average Daily Run (km		Average Consumption Rate		Average Fuel Consumption		Average Energy Consumption (kWh/yr)			Average GHG Emission (kg/yr)		
		Octane	CNG	Octane (km/l)	CNG (km/m3)	Octane (L/yr)	CNG (m3/yr)	Octane	CNG	Total	Octane	CNG	Total
Toyota Allion	44	3.48	47.82	6.63	7.11	185.29	2619.86	1652.13	27799.34	29451.46	399.68	5030.13	5429.81
Toyota Axio	34	4.44	53.65	7.46	7.09	136.68	1741.28	1218.75	18476.70	19695.45	294.84	3343.25	3638.09
Toyota Corolla X	75	3.64	49.81	6.72	7.01	184.05	3769.05	1641.14	39993.42	41634.56	397.02	7236.58	7633.61
Toyota Premio	39	3.92	45.23	7.36	7.22	184.94	2920.51	1649.09	30989.53	32638.62	398.95	5607.38	6006.33
Toyota Feilder	15	6.13	66.80	7.47	6.97	186.05	3501.89	1658.91	37158.53	38817.44	401.32	6723.62	7124.95
Toyota Corolla Variants	14	4.82	32.89	6.71	7.25	570.30	8233.50	5085.18	87365.64	92450.82	1230.21	15808.31	17038.52
Toyota Noah	10	3.80	55.20	6.60	7.20	244.69	3094.98	2181.80	32840.80	35022.60	527.82	5942.36	6470.18
Toyota Other Models	24	2.79	43.33	7.02	7.02	730.36	6461.05	6512.38	68558.24	75070.61	1575.47	12405.22	13980.70
Mitsubishi	2	3.50	29.00	6.50	7.50	201.37	1395.95	1795.51	14812.45	16607.96	434.37	2680.23	3114.60
Others	1	2.00	10	7.00	8.00	74.29	3250	662.38	34485.75	35148.13	160.24	6240.00	6400.24
Total	258												

Figure 57: Parameters are catalogued based on Car Model (for Bi-Fuel)

E79

Manufacturing Yea	Count	Average Daily Run (	Average Consumption Rate (k	Average Fuel Consumption	Average Energy Consumptio	Average GHG Emission (kg/yr)
1986	0	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	1	25.00	5.00	1550.21	13822.69	3343.99
1993	1	28.00	6.00	1704.17	15195.49	3676.09
1994	2	55.00	7.00	2516.31	22437.10	5427.98
1996	0	0	0	0	0	0
1997	1	30.00	8.00	1505.47	13423.76	3247.48
1998	1	10.00	8.00	456.25	4068.23	984.19
1999	1	20.00	4.50	1847.22	16471.06	3984.68
2000	1	10.00	8.00	1463.77	13051.96	3157.53
2001	0	0	0	0	0	0
2002	1	20.00	7.00	939.59	8377.97	2026.80
2003	2	15.00	6.50	1402.85	12508.70	3026.11
2004	3	44.67	8.67	1505.98	13428.36	3248.59
2005	9	30.33	7.39	1483.20	13225.18	3199.44
2006	6	29.67	9.33	1163.20	10371.88	2509.16
2007	12	33.67	6.33	3236.43	28858.14	6981.36
2008	7	24.43	8.64	979.99	8738.26	2113.96
2009	5	28.40	7.40	4697.50	41886.04	10133.07
2010	9	38.19	8.03	1614.44	14395.41	3482.54
2011	6	28.33	7.58	1097.12	9782.64	2366.62
2012	20	25.05	7.15	1666.17	14856.69	3594.13
2013	13	22.69	9.08	953.54	8502.44	2056.91
2014	16	37.56	8.91	1809.43	16134.09	3903.16
2015	16	45.00	7.50	1823.41	16258.71	3933.31
2016	14	46.43	8.50	2221.43	19807.78	4791.90
2017	9	66.67	8.22	1889.05	16844.03	4074.91
2018	3	42.67	8.33	549.19	4896.93	1184.67
Total	159					

Figure 58: Parameters are cataloged based on Car Manufacturing Year (for gasoline)

Manufacturing Yea	Count	Average Daily Run (km)		Average Consumption Rat		Average Fuel Consumption		Average Energy Consumption (kWh/yr)			Average GHG Emission (kg/yr)		
		Octane	CNG	Octane (km/L	CNG (km/m3	Octane (L/yr)	CNG (m3/yr)	Octane	CNG	Total	Octane	CNG	Total
1986	1	1.00	5.00	7.00	6.00	309.60	16077.50	2799.10	170598.35	173397.46	677.16	30868.80	31545.96
1990	2	5.00	30.00	8.50	7.00	663.74	4795.00	5375.92	50879.75	56855.67	1445.70	9206.40	10652.10
1991	2	3.50	23.00	8.50	8.00	826.47	6935.89	7400.04	73596.72	80996.76	1790.22	13316.91	15107.12
1992	3	2.33	36.00	6.67	8.33	2890.71	15870.04	25867.44	168397.04	194264.48	6257.85	30470.49	36728.34
1993	2	3.00	24.00	7.75	7.00	281.09	4487.50	2556.38	47616.86	50173.24	618.44	8616.00	9234.44
1994	10	5.50	61.00	6.50	7.35	158.51	3093.88	1523.71	32829.14	34352.85	368.62	5940.25	6308.86
1996	3	2.33	42.67	7.00	7.67	520.29	5826.07	4695.40	61820.39	66515.79	1135.91	11186.05	12321.96
1997	4	1.50	34.00	7.38	6.88	405.65	3808.03	3630.53	40406.99	44037.52	878.30	7311.41	8189.71
1998	1	8.00	12.00	7.00	8.00	1043.42	13010.15	12183.59	138050.70	150234.29	2947.45	24979.49	27926.94
1999	3	1.67	35.00	5.00	6.50	1225.57	15930.05	11610.31	169033.77	180644.09	2808.77	30585.70	33394.47
2000	2	5.00	60.00	6.50	6.50	1140.16	9683.10	10552.64	102747.41	113300.05	2552.89	18591.56	21144.45
2001	8	3.00	59.25	6.25	6.69	383.84	4548.96	3483.91	48263.00	51752.91	842.83	8734.00	9576.83
2002	6	2.50	45.83	6.67	6.75	209.99	7787.22	1947.42	82630.16	84577.58	471.12	14951.46	15422.58
2003	24	3.21	40.29	6.33	6.94	354.87	5369.82	3408.27	56979.13	60387.40	824.53	10310.05	11134.58
2004	19	2.71	50.55	6.97	7.08	145.42	3931.62	1354.11	41718.46	43072.57	327.59	7548.72	7876.31
2005	39	4.33	49.36	6.99	6.86	184.63	3520.48	1823.23	37355.83	39179.05	441.08	6759.32	7200.40
2006	17	4.18	43.00	7.03	7.41	184.21	3030.84	1788.77	32160.20	33948.97	432.74	5819.20	6251.94
2007	12	5.83	51.42	6.88	7.96	192.66	2783.09	1938.63	29595.02	31533.65	468.99	5355.05	5824.04
2008	14	3.36	53.43	6.61	6.61	178.98	2882.29	1695.49	30583.94	32279.43	410.17	5533.99	5944.16
2009	6	5.17	69.00	8.17	7.50	174.23	2402.40	1714.40	25491.82	27206.23	414.75	4612.60	5027.35
2010	27	3.63	45.59	7.33	7.11	103.90	1759.10	1063.04	18665.79	19728.84	257.17	3377.47	3634.64
2011	13	3.38	41.85	6.38	7.31	120.81	1698.25	1281.74	18020.13	19301.86	310.08	3260.64	3570.72
2012	19	5.16	61.68	7.32	6.97	96.89	1218.97	953.40	12934.54	13893.94	232.10	2340.43	2572.53
2013	8	4.00	54.13	7.38	6.88	77.44	922.49	787.19	9788.50	10575.68	190.44	1771.17	1961.61
2014	6	6.00	65.67	7.33	8.17	127.99	801.13	1460.89	8500.83	9961.72	353.42	1538.18	1891.60
2015	6	3.00	42.50	8.83	8.67	174.34	2410.34	2033.22	25576.14	27609.36	491.88	4627.86	5119.73
2016	1	4.00	26.00	7.00	9.00	69.21	363.33	712.03	3855.33	4567.36	172.25	697.60	869.85
2017	0									0.00			0.00
2018	0									0.00			0.00
Total	258												

Figure 59: Parameters are cataloged based on Car Manufacturing Year (for Bi-Fuel)

Current Scenario of the Traffic of Bangladesh

Number of Vehicles Registered in Bangladesh

Bangladesh Road Transport Authority

NUMBER OF REGISTERED MOTOR VEHICLES IN DHAKA (YEARWISE)

Sl. No	Type of Vehicles	Upto-2010	2011	2012	2013	2014	2015	2016	2017	2018	Up to Sep/2019	Grand Total
1	Ambulance	1374	137	114	190	254	358	287	400	456	349	**3919**
2	Auto Rickshaw	7664	112	111	60	56	428	582	42	5637	6742	**21434**
3	Auto Tempo	1662	1	1	0	0	0	0	0	0	0	**1664**
4	Bus	16783	1501	1218	971	1364	2221	3479	3294	2322	2215	**35368**
5	Cargo Van	3231	477	278	676	603	398	1001	1285	1224	3	**9176**
6	Covered Van	4277	1910	1170	1850	2352	1855	2613	4030	4381	1947	**26385**
7	Delivery Van	11990	839	577	709	901	1464	1898	2199	1882	1005	**23464**
8	Human Hauler	2718	569	145	115	109	502	787	217	211	0	**5373**
9	Jeep(Hard/Soft)	19520	1698	1241	1107	1582	3109	4217	4712	4864	3717	**45767**
10	Microbus	46202	3540	2643	2227	3842	4569	5169	4927	3585	2426	**79130**
11	Minibus	9490	136	103	83	135	103	164	159	185	127	**10685**
12	Motor Cycle	210081	34708	32810	26331	32894	46764	53738	75251	104064	76104	**692745**
13	Pick Up (Double/Single Cabin)	20481	7258	5149	4908	7295	7916	8482	10300	9615	6836	**88240**
14	Private Passenger Car	163004	11423	8187	9231	12972	18422	18010	19573	16319	11279	**288420**
15	Special Purpose Vehicle	759	60	28	78	50	66	224	233	502	289	**2289**
16	Tanker	817	152	90	136	163	146	209	188	326	187	**2414**
17	Taxicab	36011	52	43	4	302	54	30	4	94	7	**36601**
18	Tractor	9923	4169	2841	1634	1443	1637	2510	2754	3359	1978	**32248**
19	Truck	26922	4205	2824	3522	5767	4424	4553	7035	8731	5110	**73093**
20	Others	168	0	0	660	967	1307	2567	3145	3592	2412	**14818**
TOTAL		**593077**	**72947**	**59573**	**54492**	**73051**	**95743**	**110520**	**139748**	**171349**	**122733**	**1493233**

Number of Vehicles Using IC Engine

Type of Vehicles	Up to-2010	2011	2012	2013	2014	2015	2016	2017	2018	Up to Sep/2019	% of ICE
Ambulance	1374	137	114	190	254	358	287	400	456	349	0.27%
Bus	16783	1501	1218	971	1364	2221	3479	3294	2322	2215	2.41%
Cargo Van	3231	477	278	676	603	398	1001	1285	1224	3	0.63%
Covered Van	4277	1910	1170	1850	2352	1855	2613	4030	4381	1947	1.80%
Delivery Van	11990	839	577	709	901	1464	1898	2199	1882	1005	1.60%
Jeep (Hard/Soft)	19520	1698	1241	1107	1582	3109	4217	4712	4864	3717	3.12%
Microbus	46202	3540	2643	2227	3842	4569	5169	4927	3585	2426	5.40%
Minibus	9490	136	103	83	135	103	164	159	185	127	0.73%
Motor Cycle	210081	34708	32810	26331	32894	46764	53738	75251	104064	76104	47.29%
Pick Up (Double/Single Cabin)	20481	7258	5149	4908	7295	7916	8482	10300	9615	6836	6.02%
Private Passen-ger Car	163004	11423	8187	9231	12972	18422	18010	19573	16319	11279	19.69%
Special Purpose Vehicle	759	60	28	78	50	66	224	233	502	289	0.16%
Tanker	817	152	90	136	163	146	209	188	326	187	0.16%
Taxicab	36011	52	43	4	302	54	30	4	94	7	2.50%
Tractor	9923	4169	2841	1634	1443	1637	2510	2754	3359	1978	2.20%
Truck	26922	4205	2824	3522	5767	4424	4553	7035	8731	5110	4.99%
Others	168	0	0	660	967	1307	2567	3145	3592	2412	1.01%
TOTAL	581,033	72,265	59,316	54,317	72,886	94,813	109,151	139,489	165,501	115,991	

Vehicle Using Gasoline as Preferred Fuel

Car Model Name	Reg. Year	Man Year	Engine Capacity	Current Mileage	Initial Mileage	Daily Runs	Consump-tion Rate	License Plate
Toyota Premio	2016	2015	1500	10000	1000	25	10	Chatta Metro GA 13-3337
Toyota Feilder	2009	2006	1500	32000	5000	3	12	Dhaka Metro Ga 31-6756
Toyota Premio	2016	2010	1500	19000	17000	5	7.5	Dhaka metro-GA 20-9414
Nissan Xtrail	2018	2015	2000	6000	5000	10	4	N/A
Toyota Premio	2014	2013	1500	60000	5000	50	7.5	Dhaka Metro Ga 39-5665
Toyota Premio	2015	2014	1500	55000	6000	60	9	Dhaka Metro GA-16-0246
Toyota Prado	1996	1992	2400	198274	20000	25	5	Dhaka Metro GA 02-2375
Toyota Allion	2009	2007	1500	84280	13550	26	8	Dhaka Metro Ga 27-9152
Toyota Premio	2015	2012	1500	50000	20000	4	10	Dhaka Metro Ga 39-4952
Toyota Allion	2014	2011	1500	28000	8400	10	10	Dhaka Metro Ga 21-2838
Honda Insight (Hybrid)	2013	2013	1300	42000	211	8	11	Dhaka Metro Ga 35-6093
Toyota Premio	2013	2011	1500	39000	6500	20	8	Dhaka Metro Ga-35-4654
Toyota Allion	2014	2007	1500	66800	24000	18	8	Dhaka Metro Ga 37-0006
Toyota Axio	2015	2014	1800	54103	1500	20	8	Dhaka Metro Ga 34-1242
Honda Civic	2005	2003	1500	80791	10000	20	7	Dhaka Metro Ga 29-2641
Nissan Bluebird	2009	2009	1500	39200	200	20	8	Dhaka Metro Ga 37-9877
Audi A8	2014	2013	2000	75000	21	50	4.5	Dhaka Metro Ga 37-1442
Honda Vezel	2019	2018	1800	500	150	8	12	Dhaka Metro Ga 17-8809
Mitsubishi Outlander	2015	2015	2400	47000	0	70	3.5	Chattra Metro Ga 11-2138
Toyota Premio	2016	2016	1500	90000	350	100	8	Dhaka Metro Ga 26-7269
Toyota Axio	2015	2010	1500	76000	36000	70	3.5	Dhaka Metro Ga 22-1091
Mazda Axela	2018	2016	2500	14000	380	25	9	Dhaka metro Gha 12-4065
Honda Vezel	2018	2014	1500	56000	34000	80	12	Dhaka Metro Gha 17-3455
Toyota Axio	2012	2008	1500	75000	10000	25	10	Dhaka Metro Ga 33-1421
Toyota IST	2009	2005	1300	104000	30000	5	10	Chattra Metro Kha 11-1368
Toyota Avanza	2014	2010	1500	102000	10000	60	10	Chattra Metro Ga 11-1687
Hyundai Xcent	2016	2015	1300	25000	0	15	9	Dhaka Metro Kha 11-9206
Toyota Fielder	2018	2013	1500	50000	45000	25	10	Dhaka Metro Ga 28-4163
Toyota Premio	2010	2007	1500	40000	1328	20	6	Dhaka Metro Ga 31-2013
Toyota Fielder	2010	2005	1500	99216	44000	14	7	Dhaka Metro Ga 27-5587
Toyota Vitz	2017	2012	1300	51500	39300	7	9	Dhaka Metro Kha 13-3738
Toyota Corolla X	2010	2006	1500	129000	10000	10	9	Dhaka Metro Ga 27-9575
Toyota Allion	2015	2013	1500	55000	15000	10	10	Dhaka Metro Ga 22-1195
Toyota Axio	2014	2008	1500	82000	34000	30	9	Dhaka Metro Ga 35-9191
Toyota Probox	2007	2004	1300	129255	15000	39	9	Dhaka Metro Gha 12-6180
Toyota Premio	2012	2010	1500	27000	5000	60	8	Dhaka Metro Ga 32-7873
Mitsubishi Outlander	2017	2008	2000	59959	45000	5	9	Dhaka Metro Gha 15-4434
Toyota Allion	2016	2012	1500	94000	27000	15	8	Dhaka Metro Ga 12-3456
Toyota Aqua	2017	2013	1500	80000	65000	5	10	Dhaka Metro Ga 34-8591
Toyota Allion	2016	2014	1500	60000	6000	8	8	Dhaka Metro Ga 12-4345
Mitsubishi Lancer	2013	2012	1500	72000	0	20	8	Dhaka Metro Ga 35-1681
Toyota Allion	2015	2011	1500	57427	18500	15	8	Dhaka Metro Ga 31-9767

Toyota Premio	2018	2016	1500	9840	2100	25	11	Dhaka Metro Ga 34-6167
Toyota Axio	2016	2014	1500	98000	25000	100	10	Dhaka Metro Ka 27-3883
Toyota Yaris	2016	2016	1500	48000	0	80	8	Chattra Metro Ga 12-2598
Toyota Premio	2016	2016	1500	10000	28	10	11	Dhaka Metro Ga 20-1940
Toyota Axio	2016	2012	1500	9000	2000	10	8	Dhaka Metro Ga 34-4360
Toyota Chaser	2003	1999	2000	200000	67000	20	4.5	Dhaka metro Ga 15-7632
Toyota Camry	1999	1993	1800	210000	5500	28	6	Dhaka Metro Ga 12-1616
Toyota Axio	2013	2007	1500	68000	28000	25	7	Dhaka Metro Ga 35-4394
Toyota Premio	2018	2014	1500	55000	42500	15	8	N/A
Toyota Allion	2015	2010	1500	67000	48000	25	8	Dhaka Metro Ga 12-3456
Toyota Premio	2019	2016	1500	56500	1600	50	10	Dhaka Metro Ga 42-1751
Toyota Celica	2016	2005	1800	33000	28000	8	8	Dhaka Metro Ga 26-8504
Toyota Axio	2019	2013	1500	45300	45000	25	9	Dhaka Metro Ga 42-6087
Toyota Premio	2013	2009	1500	700000	30000	7	7	Dhaka Metro Ga 35-4136
Ssangyong Actyon	2011	2010	2400	70000	20000	30	3.5	Chatta Metro Ga 13-25
Toyota Corolla X	2007	2003	1500	200000	50000	10	6	Dhaka Metro Ga 19-8448
Toyota Axio	2014	2008	1500	84000	34000	40	10	Dhaka Metro Ga 35-9191
Toyota Corolla	2015	2013	1500	119040	100000	7	8	Dhaka Metro Ga 22-2644
Toyota Axio	2013	2010	1500	45000	5000	18	9	Dhaka Metro GA 33-4786
Toyota Premio	2018	2016	1300	20000	700	50	6	Dhaka metro GA 34-5312
Toyota Corolla X	2010	2005	1500	147670	122540	8	13	Chattra metro GA 12-1597
Honda CRV	2017	2012	2000	87000	14000	100	4	Dhaka Metro Cha 17-1691
Toyota Allion	2008	2006	1500	60225	3000	15	11	Dhaka Metro Ga 33-4898
Honda Vezel	2014	2014	1500	11945	0	2	11	Dhaka Metro Ga 13-8596
Toyota Carina	2003	1997	1600	198700	6000	30	8	Chatta Metro Ga 11-4164
Toyota Axio	2012	2008	1500	61300	37980	11	8	Dhaka Metro Ga 33-6946
Ssangyong Korando	2016	2015	2000	31250	0	20	6	Dhaka Metro Gha 15-3706
Toyota Rush	2009	2006	1500	85000	52000	50	7	N/A
Toyota Premio	2015	2013	1500	35000	1700	5	11	Dhaka Metro Ga 21-6356
Toyota Allion	2016	2014	1500	11350	400	10	10	Dhaka Metro Ga 26-9824
Toyota Estima	2011	2007	2400	567282	19937	25	5	Dhaka Metro Cha 11-6488
Toyota Vitz	2015	2009	1300	44000	20000	15	8	Chatta Metro Kha 11-2496
Toyota Axio	2017	2011	1500	52000	32000	15	7	Dhaka Metro Ga 26-8251
Toyota Allion	2009	2002	1500	72471	6700	20	7	Dhaka Metro Ga 19-5117
Toyota Corolla X	2010	2005	1500	131224	65000	20	8	Dhaka Metro Ga 29-5655
Toyota Allion	2012	2007	1500	66099	22000	60	6	Dhaka Metro Ga 33-2946
Toyota Noah Hybrid	2017	2016	1800	38100	1500	20	10	Dhaka Metro Cha 19-6664
Hyundai Kia	2012	2011	2000	37300	0	30	4.5	Dhaka Metro Gha 13-4418
Toyota Fielder	2018	2012	1500	44574	26000	50	8	Dhaka Metro Ga 34-7607
Nissan Xtrail	2017	2012	2000	96250	88000	10	5	Dhaka Metro Gha 15-7538
Toyota Axio	2018	2012	1500	27816	16100	10	8	Dhaka Metro Ga 34-3540
Toyota Axio	2018	2013	1500	52850	42970	40	8	Dhaka Metro Ga 28-4517
Toyota Allion	2018	2015	1500	59795	40000	50	6	Dhaka Metro Ga 28-4254
Toyota Noah	2015	2015	3200	59664	0	60	4.5	Dhaka Metro Ca 16-2082

Toyota Allion	2008	2004	1500	166700	50000	45	9	Dhaka Metro Ga 21-4085
Toyota Premio	2012	2008	1500	92729	25000	30	7	Dhaka Metro Ga 32-0448
Toyota Allion	2008	2008	1500	101887	0	30	7.5	Dhaka Metro Ga 31-9297
Toyota Premio	2007	2005	1500	70886	3000	18	6	Dhaka Metro Ga 27-8715
Toyota Fielder	2010	2009	1500	200000	350	40	7	Dhaka Metro Ga 39-5707
Toyota Corolla X	2018	2017	1500	3544	0	50	9	Dhaka Metro Ga 28-2597
Mitsubishi Outlander	2017	2012	2000	23175	20000	4	5	Dhaka Metro Gha 15-5327
Toyota Axio	2016	2015	1500	121424	1500	100	11	Dhaka Metro Ga 34-6203
Toyota Harrier	2018	2014	2000	29413	0	4	5.5	Dhaka Metro Gha 15-5491
Toyota Allion	2008	2007	1800	107312	0	25	4	Dhaka Metro Ga 35-3839
Toyota Corolla X	2001	2000	1500	255783	45000	10	8	Dhaka Metro Ga 21-7791
Toyota Premio	2018	2016	1500	20000	5400	40	7	Chatta Metro Ga 13-6277
Toyota Corolla X	1999	1994	1500	473480	2500	60	6	Dhaka Metro Ga 21-2314
Nissan Selero	2005	2005	2400	60679	0	60	3.5	Dhaka Metro Da 11-1054
Toyota Premio	2013	2007	1500	120227	4800	30	6	Dhaka Metro Ga 37-0351
Toyota Noah	2018	2012	2000	10000	2000	30	5	Dhaka Metro GHA 12-1986
Toyota Premio	2015	2015	1500	20000	150	20	8	Dhaka Metro GA 39-4400
Toyota Vitz	2016	2011	1300	61427	21000	80	8	Dhaka Metro Ga 28-3469
Toyota Premio	2009	2007	1500	682308	21000	70	6	Dhaka Metro Ga 23-1023
Toyota Axio	2009	2005	1500	193752	26000	60	6	Dhaka Metro Ga 23-9008
Toyota Corolla X	2009	1994	1500	181223	92600	50	8	Dhaka Metro Ga 25-2814
Toyota Allion	2016	2015	1500	15048	1000	50	10	Dhaka Metro Ga 39-3622
Toyota Allion	2016	2015	1500	38561	1500	60	9	Dhaka Metro Ga 35-4247
Mitsubishi Asx 19	2019	2018	2000	6842	0	20	5	Dhaka Metro Gha 18-1778
Honda Vezel	2017	2016	1500	24610	800	50	8	Dhaka Metro Gha 15-6606
Toyota Premio	2016	2014	1500	32000	18000	25	10	Chatta Metro Ga 13-3289
Honda 2014	2015	2014	1500	33796	150	30	10	Dhaka Metro Gha 13-8896
Toyota Allion	2008	2005	1500	315680	18000	80	5	Dhaka Metro Ga 31-3940
Toyota Premio	2017	2015	1500	25539	14000	30	8	Dhaka Metro Ga 22-5029
Toyota Ractis 2012	2017	2012	1500	25222	10500	25	10	Dhaka Metro Ga 28-2068
Toyota Allion	2019	2015	1500	33647	19300	60	8	Dhaka Metro Ga 34-5369
Mercedes S320	2014	2014	3200	91073	0	50	6	Dhaka Metro Va 02-0504
Toyota Allion	2008	2006	1500	221625	20857	50	7	Dhaka Metro GA 21-9616
Toyota Premio	2011	2010	1500	132730	86270	75	7	Dhaka Metro GA 35-5100
Toyota Allion	2016	2014	1500	20343	7032	25	12	Dhaka Metro Ga 34-3040
Toyota Allion	2005	2004	1500	273750	18250	50	8	Chatta Metro Ga 11-7181
Toyota Allion	2014	2012	1500	48043	9000	30	7	Dhaka Metro Ga 33-6424
Toyota Corolla X	2015	2010	1500	87660	29260	40	8	Chatta Metro GA 13-0270
Toyota Starline	1999	1998	1300	21185310	138853	10	8	Dhaka Metro GA 15-4578
Mercedes E Class	2017	2017	2000	9672	0	30	4	Dhaka Metro GHA 34-2633
Toyota Premio	2014	2013	1500	58757	1300	50	8	Dhaka Metro GA 37-6153
Toyota Premio	2014	2014	1500	91250	0	50	8	Dhaka Metro GA 22-6235
Toyota Premio	2018	2017	1500	7000	280	100	8	Dhaka Metro GA 42-6129
Toyota Premio	2017	2013	1500	34000	26700	10	11	Dhaka Metro GA 26-4896

Toyota Premio	2010	2007	1500	63200	15000	20	6	Dhaka Metro GA 27-6445
Nissan Xtrail	2018	2012	2000	94125	85000	25	5	Dhaka Metro Ga 17-2335
Toyota Allion	2014	2007	1500	98600	63000	50	8	Dhaka Metro Ga 35-6439
Toyota Axio	2015	2009	1500	141600	54000	60	7	Dhaka Metro GA 37-4362
Toyota Axio	2018	2015	1500	61000	40000	50	7	Dhaka Metro Ga 42-3944
Audi A3	2018	2017	1400	27016	0	60	10	Dhaka Metro GA 37-5859
Toyota Vitz	2017	2012	1300	57300	43000	20	7	Dhaka Metro KA 114890
Toyota Vitz	2017	2012	1300	57425	40000	30	6	Dhaka Metro KA 114903
Toyota Axio	2014	2007	1500	105938	45000	35	6	Dhaka Metro GA 37-1863
Hyundai	2016	2015	2000	54750	0	60	6	Dhaka Metro GHA 11-9764
Toyota Premio	2017	2016	1500	46325	7000	70	8	Dhaka Metro GA 26-0233
Toyota Premio	2018	2016	1500	33704	15000	50	8	Dhaka Metro GA 34-2421
Toyota Axio	2019	2016	1500	47368	28500	60	7	Dhaka Metro GA 20-8343
Toyota Axio	2019	2017	1500	29401	15000	80	8	Dhaka Metro GA 42-6530
Toyota Premio	2015	2014	1500	130750	3000	100	8	Dhaka Metro GA 21-9822
Toyota Premio	2018	2017	1500	15100	500	80	9	Dhaka Metro GA 33-3499
Toyota Premio	2018	2017	1500	8300	1000	20	8	Dhaka Metro GA 42-9086
Toyota Premio	2018	2017	1500	45800	0	120	9	Dhaka Metro GA 42-7301
Toyota Premio	2019	2017	1500	22900	1000	60	9	Dhaka Metro GA 42-0195
Toyota Premio	2017	2016	1500	20000	100	20	8	Dhaka Metro Ga14-3976
Toyota Allion	2017	2013	1500	29509	23000	10	10	Dhaka Metro Ga 11-8734
BMW	2019	2018	2000	2000	0	100	8	Dhaka Metro Ga 29-6565
Mitsubishi Outlander	2015	2012	2000	70000	18000	36	6	Dhaka Metro Gha 15-1340
Toyota Axio	2017	2012	1500	58600	44000	20	8	Dhaka Metro Ga 28-2220
Toyota Axio	2010	2006	1500	165000	9000	50	10	Dhaka Metro Ga 20-5353
Mitsubishi Outlander	2019	2015	2000	38400	25000	40	10	Dhaka Metro Gha 18-2300
Toyota Premio	2017	2012	1500	31218	15777	25	9	Chatta Metro Ga 13-6381
Toyota Premio	2017	2014	1500	18000	4700	22	7	Chatta Metro Ga 13-5278
Toyota Noah	2018	2012	2000	31000	20000	30	7	Chatta Metro Ga 11-8171

Vehicle Using Bi-Fuel as Preferred Fuel

Car Model Name	Reg Year	Man Year	CNG Conv	Engine Cap	Current Mileage	Initial Mileage	Daily Runs	Run (Gaso)	Consume Rate (Gaso)	Run (CNG)	Consume Rate (CNG)	License Plate
Toyota Premio	2009	2006	2009	1500	160000	25000	70	10	7	60	7	Chattra Metro GA 12-3044
Toyota Allion	2009	2006	2010	1500	60000	13000	30	1	8	29	7	Dhaka Metro Ga 296998
Toyota Probox	2005	2001	2007	1400	189000	85000	48	3	7	45	7.5	Dhaka Metro Kha 13-1415
Toyota Corolla X	2008	2005	2008	1500	327815	20000	40	8	10	30	6	Dhaka Metro Ga 23-5141
Toyota Premio	2016	2015	2016	1500	35000	4000	15	5	10	10	9	Dhaka Metro Ga 22-3228
Toyota Axio	2017	2012	2017	1500	120000	16000	80	5	10	75	8	Dhaka Metro Ga 34-8278
Toyota Tercel	2002	1997	2008	1300	212000	35000	30	1	10	29	7	N/A
Toyota Corolla X	2006	2004	2007	1500	166243	3000	60	2	7	58	8	Dhaka Metro Ga 31-5754
Toyota Corolla Sprinter	2000	1998	2006	1700	265203	5000	20	8	7	12	8	N/A
Toyota Axio	2011	2006	2012	1500	110000	29000	25	5	10	20	7	Dhaka Metro Ga 31-9370
Toyota Axio	2016	2013	2016	1500	22000	3000	15	2	6	13	7	Dhaka Metro Ga 22-0536
Toyota Corolla X	2010	2006	2011	1500	200000	27000	40	2	6	38	7	Chotto Metro Ga 11-6945
Toyota Corolla X	2010	2005	2010	1500	108000	30000	45	2	10	43	8	Dhaka Metro Ga 31-5001
Toyota Corolla X	2007	2003	2007	1500	220000	49000	30	2	7	28	6	Dhaka Metro Kha 12-4380
Toyota Corolla	1990	1986	2010	1500	105465	9000	6	1	7	5	6	Dhaka Metro Ga 02-1016
Toyota Allion	2014	2006	2014	1500	70000	22000	12	2	7	10	7	Dhaka Metro Ga 21-8046
Toyota 90	1994	1990	2009	1300	400000	3000	50	5	7	45	7	Dhaka Metro Kha 11-3032
Toyota Allion	2010	2008	2010	1500	150000	20560	20	3	6.5	17	6	Dhaka Metro Ga 29-0055
Toyota Premio	2007	2003	2009	1500	120000	15000	7	2	6	5	6	Dhaka Metro Ga 19-4000
Toyota Axio	2017	2014	2017	1500	83000	32000	100	3	6	97	8	Dhaka Metro Ga 32-8431
Toyota Fielder	2011	2007	2012	1500	100000	20000	12	2	8	10	7	Dhaka Metro Ga 25-8485
Toyota Fielder	2007	2005	2007	1500	120000	5000	20	1	10	19	7	Dhaka Metro Ga 21-2715
Toyota Axio	2008	2008	2012	1500	200000	145	90	5	9	85	8	Chatta Metro Ga 12-8198
Toyota Premio	2012	2010	2012	1500	51000	10000	20	2	9	18	8	Dhaka Metro Ga 33-34636
Toyota Allion	2009	2004	2010	1500	100000	16277	30	2	6	28	7	Chatta Metro Ga 12-0850
Toyota Corolla X	2012	2006	2012	1500	300000	185000	20	2	6	18	8	Dhaka Metro Ga 33-6521
Toyota Corolla X	2010	2006	2012	1500	160000	18000	50	2	7.5	48	6	Dhaka Metro Ga 31-3694
Toyota Corolla X	2008	2003	2009	1500	69543	25430	25	3	6	22	6	Chatta Metro Ga 12-0326
Toyota Corolla X	2010	2004	2010	2000	200000	48000	20	1	5	19	6	N/A
Toyota Corolla X	2009	2006	2010	1500	212523	15000	50	2	8	48	7	Dhaka Metro Ga 25-3980
Toyota Corolla	2007	1999	2007	1300	280378	58000	15	1	3	14	7	Chatta Metro Ga 11-6238)
Toyota Corolla GLI	2005	2003	2008	1500	100000	5000	50	5	6	25	7	Dhaka Metro GA 21-4519
Mitsubishi Pajero	1999	1994	2010	3000	115000	30000	35	3	6	32	6	Dhaka metro Gha 14-0067
Toyota Carina	1995	1991	2008	1500	574980	25000	45	2	7	43	9	Dhaka Metro Ga 11-4567
Toyota Corolla X	2011	2005	2007	1500	107123	53000	12	2	7	10	9	Dhaka Metro Ga 31-0641
Toyota Corolla 110	2000	1996	2007	1500	274000	23500	25	3	7	22	8	Dhaka Metro Ga 14-26**
Toyota Corona	1999	1996	2007	1500	256348	70000	40	2	6	38	6	Dhaka metro Ga 14-0379
Toyota Corolla	1999	1993	2006	1800	175000	90000	24	4	8	20	8	Dhaka metro Ga 13-2120
Toyota 100	1997	1993	2006	1300	200000	37000	30	2	7.5	28	6	Dhaka Metro Ga 12-1618
Toyota 111	1996	1992	2008	1500	100000	20000	5	1	6	4	7	Dhaka Metro Ga 13-5412
Toyota Corsa	1992	1990	2007	1300	65000	32000	20	5	10	15	7	Dhaka Metro Ka 03-7644
Toyota Premio	2011	2011	2011	1500	90000	1000	20	5	7	15	6	Dhaka Metro Ga 31-2156

Toyota Corolla	2007	2002	2007	1500	45000	0	100	3	8	70	5.5	Dhaka metro Ga 19-3609
Toyota Premio	2014	2010	2014	3000	44000	13000	15	3	3	12	7	Dhaka Metro Ka 12-3456
Toyota Probox	2012	2003	2012	1500	143567	33000	50	5	6	45	10	Dhaka Metro Ga 31-0655
Toyota Corolla	2004	2003	2006	1500	95000	25000	15	1	6	14	6	N/A
Toyota Corolla X	2009	2005	2009	1500	143000	37500	30	1	8	29	10	Dhaka Metro Ga 27-0807
Toyota Feilder	2017	2011	2017	1500	73000	26000	50	2	7	48	8	Dhaka Metro Ga 26 8345
Toyota Noah	2009	2003	2009	1800	56686	18589	10	2	6	8	5.5	Dhaka Metro Cha 13-3716
Toyota Corona	2005	1992	2005	1500	132200	33000	20	2	8	18	10	Dhaka Metro GA 23-5013
Toyota Feilder	2014	2010	2014	1500	95000	32000	40	2	8	35	7	Dhaka Metro GA 37-3026
Toyota AE111	2002	1997	2007	1600	150000	40000	40	1	6	39	6	N/A
Toyota Allion	2007	2005	2007	1500	149200	450	37	1	6	36	5.5	Dhaka Metro Ga 21-2482
Toyota Feilder	2009	2003	2009	1500	1000000	700000	20	6	12	14	7	Dhaka Metro GA 125406
Toyota Corolla X	2003	2000	2007	1500	400000	200	30	5	7	25	6	Dhaka Metro Ga 35-6392
Toyota Axio	2016	2011	2016	1500	126000	7000	20	2	5	18	6.5	Dhaka Metro Ga 16-022
Toyota Corolla X	2010	2004	2011	1500	103300	4750	30	3	6.5	27	8	Dhaka Metro Ga 12-3456
Toyota Allion	2010	2008	2010	1500	45446	23546	10	2	5	8	5.5	Dhaka Metro Ga 29-0777
Toyota Premio	2016	2015	2016	1800	94045	19546	8	2	9	6	10	Dhaka Metro Ga 39-4590
Toyota Premio	2007	2005	2017	1500	106000	40000	40	10	10	30	6	Dhaka Metro Ga 19-9883
Toyota 100	1999	1996	2004	1500	199465	3500	70	2	8	68	9	Dhaka Metro Ga 13-9286
Toyota Corolla X	2010	2004	2010	1500	245200	50000	60	5	8	55	6	Dhaka Metro Ga 27-6031
Toyota Premio	2013	2010	2013	1500	64216	23000	40	2	7	38	7	Dhaka Metro Ga 33-7538
Toyota Corolla X	2006	2005	2008	1500	178503	3000	40	3	7	37	6.5	Dhaka Metro Ga 29-3370
Toyota Allion	2007	2003	2007	1500	135698	70000	16	1	6	15	8	Dhaka Metro Ga 21-3722
Toyota Allion	2015	2010	2015	1500	182550	70000	100	2	8	98	10	Dhaka Metro Ga 22-0430
Toyota Axio	2011	2007	2011	1500	135074	15000	80	8	8	72	6	Dhaka Metro Ga 27-6861
Toyota Warrior	2006	2006	2007	1500	9344	0	40	3	7	37	6	Dhaka Metro Ga 29-7177
Toyota Vios	2008	2002	2008	1500	1991745	1600000	17	1	8	16	10	Dhaka Metro Ga 11-0011
Toyota Noah	2014	2012	2014	2000	163683	30000	100	10	8	90	8.5	Dhaka Metro Ca 53-9700
Toyota Feilder	2017	2012	2017	1500	176000	60000	200	7	7	193	6	Dhaka Metro Ga 32-0513
Toyota Axio	2007	2007	2007	1800	80373	0	60	8	4.5	52	8	Dhaka Metro Ga 26-7853
Toyota Corolla X	2008	2005	2008	1500	295000	30000	60	5	6	55	8	Dhaka Metro Ga 29-9188
Toyota Premio	2012	2006	2012	1500	117000	45000	45	10	6	35	9	Dhaka Metro Ga 33-5009
Toyota Corolla X	2008	2006	2008	1500	35147	2500	10	2	10	8	8	Dhaka Metro Ga 33-8890
Toyota Feilder	2017	2011	2017	1500	57700	3000	75	5	8	70	10	Dhaka Metro Ga 28-1766
Toyota Premio	2009	2009	2009	1500	87594	0	70	5	14	65	8	Dhaka Metro Ga 35-2780
Toyota Allion	2016	2015	2016	1500	66947	0	100	2	10	98	9	Dhaka Metro Ga 20-3739
Toyota Allion	2015	2013	2015	1500	77100	26000	70	14	7	56	8.5	Dhaka Metro Ga 16-2461
Toyota Premio	2014	2010	2014	1500	66525	25000	50	7	7	43	6	Dhaka Metro Ga 37-7067
Toyota Allion	2013	2005	2013	1500	81469	50000	13	1	6	12	6.5	Dhaka Metro Ga 35-6968
Toyota Feilder	2017	2011	2017	1500	71580	50000	60	2	6	58	6	Dhaka Metro Ga 32-4766
Toyota Feilder	2013	2010	2013	1500	98000	22500	70	4	6	66	7	Dhaka Metro Ga 20-1358
Toyota Allion	2003	2003	2006	1500	1039049	0	50	5	6	45	9	Dhaka Metro Ga 23-6501
Toyota Corolla	2005	2004	2008	1500	176695	1550	20	0.5	6	19.5	6	Dhaka Metro Ga 23-3384
Toyota Premio	2011	2010	2011	1500	45336	0	10	2	7	8	8	Dhaka Metro Ga 35-9853
Toyota Avanza	2015	2013	2015	1300	70000	46000	50	2	7	48	7	Dhaka Metro Ca 15-6926

Toyota Cabina	2005	2005	2008	1500	185271	0	25	1	7	24	8.5	Dhaka Metro Ga 17-0942
Toyota Corolla	2005	2003	2007	1500	124000	21800	20	1	6	19	6.5	Dhaka Metro Ga 23-7449
Toyota Corolla X	2004	2003	2008	1500	89000	1000	16	1	5	15	7	Dhaka Metro Ga 23-0660
Toyota Axio	2007	2005	2007	1500	148745	3200	100	20	12	80	9	Dhaka Metro Ga 29-8748
Toyota Noah	2006	2001	2007	1800	280309	15000	60	2	5	58	6.5	Dhaka Metro Cha 11-6517
Toyota Axio	2012	2005	2012	1500	185200	28000	80	3	7	77	6	Dhaka Metro Ga 33-5941
Toyota Noah	2009	2003	2009	2000	205885	25000	60	5	4	55	8.5	Dhaka Metro Ga 13-3763
Toyota Harrier	2006	2005	2008	2400	307219	1500	70	10	4.5	60	6	Dhaka Metro Gha 19-7974
Toyota Feilder	2005	2002	2007	1500	175690	8600	20	1	6	19	6	Dhaka Metro Ga 19-9069
Toyota Feilder	2017	2012	2017	1500	41139	3600	110	30	7	80	5.5	Dhaka Metro Ga 32-8369
Toyota Allion	2008	2007	2008	1500	80562	1000	50	4	9	46	8	Dhaka Metro Ga 29-1558
Toyota Feilder	2017	2012	2017	1500	95338	4500	50	5	5	45	6	Dhaka Metro Ga 28-4187
Toyota Corona	1995	1992	2008	1800	2400612	2100	90	4	6	86	8	Dhaka Metro Ga 11-6038
Toyota Allion	2015	2011	2015	1500	54249	3500	50	3	6.5	47	9	Dhaka Metro Ga 39-8427
Toyota Allion	2015	2011	2015	1500	4958	2300	4	1	5.5	3	6	Dhaka Metro Ga 39-9767
Toyota Raum	2002	1999	2005	1500	109000	28000	65	2	7	63	7	Dhaka Metro Ga 15-8974
Toyota Corolla	2009	2007	2009	1500	381517	22500	120	20	8	100	10	Dhaka Metro Ga 23-7442
Toyota Allion	2013	2010	2013	1500	62796	15000	30	3	5	27	6	Dhaka Metro Ga 20-3040
Toyota Tercel	2002	1997	2007	1300	217000	190000	22	2	10	20	8.5	Dhaka Metro GA 13-9879
Toyota Corolla X	2008	2005	2008	1500	137000	16000	50	2	7	48	5	Chatta Metro GA 11-9531
Toyota Axio	2015	2010	2015	1500	11347	1800	8	2	10	6	6	Dhaka Metro KHA 11-4106
Toyota Prado	2008	2007	2008	2700	143840	0	40	4	4	36	10	Dhaka Metro Gha 13-1067
Toyota Corolla X	2007	1994	2007	1500	442403	60000	90	5	7	85	8	Dhaka Metro Ga 21-0702
Toyota Corolla X	2010	1994	2010	1500	215603	87500	60	6	6	54	9	Dhaka Metro Ga 27-1476
Toyota Premio	2011	2004	2011	1500	219000	102200	40	2	8	38	8	Chatta Metro Ga 12-3849
Toyota Corolla X	2013	1994	2013	1500	326809	186000	70	5	7	65	8.5	Dhaka Metro Ga 37-6939
Toyota Corolla X	2010	1994	2010	1500	453112	146000	100	10	5	90	6	Dhaka Metro Ga 31-1710
Toyota Corolla X	2011	1994	2011	1500	146593	86000	80	2	8	78	8	Dhaka Metro Ga 14-5872
Toyota Corolla X	2007	1994	2007	1500	713834	420000	70	10	6	60	7.5	Dhaka Metro Ga 21-1248
Toyota Corolla X	2013	1994	2013	1500	240900	175200	30	2	5	28	5	Dhaka Metro Kha 12-0535
Toyota Premio	2017	2007	2017	1500	351742	300000	50	5	9	45	8	Dhaka Metro Ga 22-1082
Toyota Corolla X	2007	1994	2007	1500	496819	86300	100	10	10	90	10	Dhaka Metro Ga 21-5213
Toyota Prado	2000	1997	2005	3000	285742	18000	50	2	3.5	48	6	Dhaka Metro Gha 13-4447
Toyota Corolla	2001	1999	2005	1500	1307752	39000	40	2	5	28	5.5	Dhaka Metro Ga 13-7455
Toyota Corolla X	2013	2005	2013	1500	71868	35000	15	3	5	12	6	Dhaka Metro Ga 37-4883
Toyota Corolla X	2009	2004	2009	1500	328500	109500	60	2	6	58	9	Chatta Metro Ga 12-2445
Toyota Allion	2007	2003	2007	1500	55568	29000	50	3	7	47	6.5	Dhaka Metro Ga 19-8216
Toyota Premio	2005	2003	2008	1500	350914	4500	80	3	5	77	7	Dhaka Metro Ga 27-2132
Toyota Probox	2008	2004	2008	1500	658499	3500	180	4	10	176	7.5	Dhaka Metro Ga 23-4664
Toyota Allion	2007	2004	2007	1500	212062	11000	50	2	8	48	6	Dhaka Metro Ga 21-4287
Toyota Noah	2011	2005	2011	1800	341470	85000	100	5	7	95	5.5	Dhaka Metro Ca 53-5266
Toyota Corolla X	2005	2003	2005	1500	386407	2300	80	4	8	76	6	Dhaka Metro Gha 19-1847
Toyota Axio	2015	2013	2015	1500	100000	46000	100	5	6	95	6	Dhaka Metro GA 28-2456
Toyota Corolla	2008	2004	2008	1500	200000	121200	80	3	9	77	8	Dhaka Metro Kha 12-8849
Toyota Noah	2012	2010	2012	2000	107961	2761	40	3	9	37	6	Dhaka Metro Cha 56-0531

Toyota Axio	2016	2010	2016	1500	76802	22052	50	4	8	46	7.5	Dhaka Metro Ga 20-4933
Toyota Allion	2005	2005	2005	1500	78000	0	40	2	6	38	6	Dhaka Metro Ga 31-2151
Toyota Premio	2015	2011	2015	1500	61000	4500	39	1	8	38	7	Dhaka Metro Ga 29-3751
Toyota Allion	2012	2012	2012	1500	229950	0	90	2	6	88	5	Dhaka Metro Ga 26-1892
Toyota Allion	2016	2014	2016	1500	39437	6587	30	1	7	29	8	Dhaka Metro Ga 32-1446
Toyota Premio	2011	2011	2011	1500	40919	0	70	3	5	67	6	Dhaka Metro Ga 35-5102
Toyota Corolla X	2010	2005	2010	1500	161416	6500	47	2	7	45	8	Dhaka Metro GA 25-9702
Toyota Noah	2008	2004	2008	1800	288100	7050	70	3	6	67	6	Dhaka Metro CHA 13-7200
Toyota Premio	2005	2004	2005	1500	282550	1500	55	2	6	53	5.5	Chatta Metro GA 11-6500
Toyota Corolla X	2008	2005	2008	1500	153987	5220	37	1	7	36	5	Dhaka Metro GA 29-5172
Toyota Corona	1994	1991	2006	1500	124000	32750	10	1	6	9	7	Chatta Metro GA 11-1535
Toyota Corolla X	2010	2008	2010	1500	236562	72312	50	2	6	48	8	Dhaka Metro GA 29-0490
Toyota Axio	2017	2012	2017	1500	73915	37415	50	2	6	48	7	Dhaka Metro GA 28-2451
Toyota Axio	2017	2013	2017	1500	70521	12121	80	2	9	78	5	Dhaka Metro GA 32-4747
Toyota Allion	2007	2003	2007	1500	99000	27000	40	2	6	38	7	Dhaka Metro GA 27-6957
Toyota Corolla X	2008	2005	2008	1500	217500	35000	50	5	5	45	6	Dhaka Metro GA 33-1657
Toyota Premio	2007	2005	2007	1500	282000	20000	60	4	6	56	7.5	Dhaka Metro Ga 21-1187
Toyota Axio	2010	2007	2010	1500	239900	42800	60	5	6	55	6.5	Dhaka Metro GA 22-0952
Toyota Axio	2010	2007	2010	1500	184000	20000	50	2	6	48	9	Dhaka Metro GA 22-7691
Toyota Corolla X	2007	2004	2007	1500	147536	45000	50	5	8	45	8	Dhaka Metro GA 21-8424
Toyota Corolla X	2005	2002	2005	1500	264877	18000	50	2	7	48	6.5	Dhaka Metro GA 27-5427
Toyota Feilder	2009	2005	2009	1500	431107	15000	120	10	7	110	7	Dhaka Metro GA 25-7967
Toyota Noah	2017	2012	2017	2000	26873	10000	30	2	8	28	8.5	Dhaka Metro CA 19-4065
Toyota Feilder	2010	2009	2010	1500	466375	100	150	10	7	140	8	Dhaka Metro GA 39-6133
Toyota Feilder	2011	2009	2011	1500	277050	1000	100	5	8	95	7	Dhaka Metro GA 12-9211
Toyota Premio	2008	2004	2008	1500	332453	25000	80	5	7	75	7	Dhaka Metro GA 27-4292
Toyota Noah	2002	2000	2005	2000	613954	10000	100	5	6	95	7	Dhaka Metro CHA 51-4908
Toyota Corolla X	2001	2001	2005	1500	639648	0	100	5	7	95	6	Dhaka Metro GA 17-3404
Toyota Corolla X	2008	2005	2008	1500	135226	15000	30	2	7	28	5	Dhaka Metro GA 31-0773
Toyota Corolla X	2010	2005	2010	1500	172161	45000	40	2	6	38	8	Dhaka Metro GA 25-9972
Toyota Allion	2015	2011	2015	1500	107683	30000	60	5	7	55	6	Dhaka Metro GA 39-1712
Toyota Corolla X	2013	2006	2013	1500	241608	25000	100	5	5	95	7.5	Dhaka Metro GA 35-9218
Toyota Axio	2016	2010	2016	1500	101367	50000	50	2	6	48	7	Dhaka Metro GA 20-8746
Toyota Premio	2013	2010	2013	1500	172460	30000	70	2	7	68	6.5	Dhaka Metro GA 33-1408
Toyota Premio	2009	2008	2009	1500	72050	2500	20	1	7	19	7	Dhaka Metro GA 25-9912
Toyota Corolla X	2013	2006	2013	1500	266573	10000	80	5	5	75	7	Dhaka Metro GA 37-7505
Toyota Corolla X	2007	2004	2007	1500	233609	30000	50	2	7	48	7.5	Dhaka Metro GA 19-0262
Toyota Allion	2015	2010	2015	1500	147506	42000	80	5	7	75	6	Dhaka Metro GA 15-8792
Toyota Allion	2018	2014	2018	1500	94900	50000	120	10	7	110	8	Dhaka Metro GA 17-4240
Toyota Corolla X	2011	2005	2011	1500	343162	55000	60	2	8	58	6	Dhaka Metro GA 14-3631
Toyota Corolla X	2010	2005	2010	1500	178850	50000	40	2	7	38	7	Dhaka Metro GA 12-0268
Toyota Corolla X	2012	2008	2012	1500	229125	35000	80	5	7	75	7	Dhaka Metro GA 33-2129
Toyota Allion	2009	2005	2009	1500	198927	25000	50	2	6	48	7	Dhaka Metro GA 35-3382
Toyota Corolla X	2003	1994	2005	1500	263800	90000	30	2	5	28	5.5	Dhaka Metro GA 15-6222
Toyota Corolla X	2012	2008	2012	1500	239175	25000	90	5	6	85	6.5	Dhaka Metro GA 33-2356

Toyota Corolla X	2007	2003	2007	1500	341362	27000	75	3	5	72	7	Dhaka Metro GA 19-3132
Toyota Axio	2010	2005	2010	1500	267450	50000	70	5	6	65	6	Dhaka Metro GA 39-9834
Toyota Axio	2014	2012	2014	1500	59389	10000	30	2	7	28	7.5	Dhaka Metro GA 35-8364
Toyota Allion	2015	2010	2015	1500	106938	40000	50	2	8	48	8	Dhaka Metro GA 39-2471
Toyota Axio	2016	2012	2016	1500	87300	25000	60	5	8	55	7	Dhaka Metro GA 20-6948
Toyota Corolla X	2005	2003	2005	1500	55725	10000	50	2	6	48	6	Dhaka Metro GA 23-7739
Toyota Corolla X	2010	2007	2010	1500	176125	20000	50	5	7	45	8	Dhaka Metro GA 27-8422
Toyota Axio	2012	2010	2012	1500	204900	15000	80	5	7	75	7	Dhaka Metro GA 27-1806
Toyota Axio	2014	2012	2014	1500	43850	10000	20	1	8	19	7	Dhaka Metro GA 37-1697
Toyota Corolla X	2006	2002	2006	1500	312475	35000	60	5	6	55	6.5	Dhaka Metro GA 31-5525
Toyota Corolla X	2004	2001	2008	1500	282985	17000	50	2	6	48	7	Dhaka Metro GA 23-5752
Toyota Axio	2014	2012	2014	1500	62972	15000	30	2	8	28	7	Dhaka Metro GA 37-1806
Toyota Corolla X	2011	2007	2011	1500	239700	20000	80	5	7	75	8	Dhaka Metro GA 27-2476
Toyota Allion	2009	2005	2009	1500	372750	25000	100	10	6	90	6.5	Dhaka Metro GA 25-7439
Toyota Allion	2006	2004	2008	1500	201504	18000	40	3	6	37	7	Dhaka Metro GA 31-1476
Toyota Allion	2004	2002	2005	1500	386900	15000	70	3	5	67	6	Dhaka Metro GA 23-6783
Toyota Axio	2015	2012	2015	1500	107875	18000	70	5	7	65	7	Dhaka Metro GA 34-5577
Toyota Premio	2005	2003	2008	1500	208150	10000	40	2	6	38	6.5	Dhaka Metro GA 17-5445
Toyota Corolla X	2009	2006	2009	1500	201750	25000	50	5	7	45	8	Dhaka Metro GA 25-8040
Toyota Corolla X	2005	2001	2005	1500	326651	30000	60	5	5	55	7.5	Dhaka Metro GA 17-6083
Toyota Axio	2015	2012	2015	1500	146107	15000	100	5	9	95	8	Dhaka Metro GA 34-5170
Toyota Axio	2014	2010	2014	1500	136875	35000	60	2	8	58	7	Dhaka Metro GA 35-3676
Toyota Allion	2012	2010	2012	1500	82125	10000	30	3	8	27	5.5	Dhaka Metro GA 33-6062
Toyota Premio	2011	2008	2011	1500	246375	25000	80	2	7	78	6.5	Dhaka Metro GA 31-9917
Toyota Corolla X	2008	2005	2008	1500	187562	32850	40	2	7	38	7	Dhaka Metro GA 29-3598
Toyota Premio	2013	2011	2013	1500	154106	25000	70	5	8	65	9	Dhaka Metro GA 35-3188
Toyota Allion	2016	2008	2016	1500	56938	25000	35	3	6	32	6	Dhaka Metro GA 42-1360
Toyota Corolla X	2008	2005	2008	1500	183674	30000	40	2	6	38	6	Dhaka Metro GA 24-444
Toyota Allion	2015	2013	2015	1500	97859	27000	50	3	8	47	7.5	Dhaka Metro GA 31-3458
Toyota Allion	2016	2015	2016	1500	76876	31000	50	5	8	45	8	Dhaka Metro GA 16-0468
Toyota Premio	2016	2014	2016	1500	46375	15000	30	2	8	28	7	Dhaka Metro GA 20-5295
Toyota Premio	2009	2005	2009	1500	397850	40000	100	5	7	95	7.5	Dhaka Metro GA 25-9029
Toyota Corolla X	2009	2006	2009	1500	268725	25000	70	5	6	65	8	Dhaka Metro GA 25-1905
Toyota Premio	2015	2012	2015	1500	85750	29000	60	5	7	55	9	Dhaka Metro GA 16-0329
Toyota Premio	2007	2005	2007	1500	180741	20000	40	2	7	38	7	Dhaka Metro GA 27-2564
Toyota Corolla X	2010	2005	2010	1500	335256	35000	100	10	7	90	8	Dhaka Metro GA 27-2564
Toyota Corolla X	2017	2010	2017	1500	123275	75000	90	5	8	85	6	Dhaka Metro GA 26-6562
Toyota Premio	2012	2010	2012	1500	158610	15000	60	5	9	55	8.5	Dhaka Metro GA 32-2601
Toyota Premio	2015	2013	2015	1500	82874	18000	50	2	8	48	8	Dhaka Metro GA 20-4255
Toyota Premio	2016	2013	2016	1500	72928	27000	50	2	8	48	6	Dhaka Metro GA 20-7925
Toyota Corolla X	2005	2001	2005	1500	434261	30000	80	3	7	77	6	Dhaka Metro GA 17-6683
Toyota Premio	2014	2012	2014	1500	44976	12000	20	1	7	19	5.5	Dhaka Metro GA 39-4510
Toyota Corolla X	2010	2008	2010	1500	197150	10000	60	2	7	58	7	Dhaka Metro GA 27-0405
Toyota Corolla X	2006	2003	2006	1500	249462	20000	50	2	7	48	6.5	Dhaka Metro GA 31-8628
Toyota Allion	2015	2011	2015	1500	98975	35000	50	5	6	45	5.5	Dhaka Metro GA 39-1079

Toyota Axio	2012	2010	2012	1500	177625	10000	70	5	7	65	7	Dhaka Metro GA 27-9288
Toyota Corolla X	2011	2008	2011	1500	192626	25000	60	5	7	55	6	Dhaka Metro GA 14-8434
Toyota Corolla X	2005	2001	2005	1500	284103	35000	50	2	6	48	7	Dhaka Metro GA 17-6500
Toyota Premio	2012	2009	2012	1500	99621	27000	30	5	7	28	7	Dhaka Metro GA 32-5602
Toyota Premio	2012	2009	2012	1500	238600	25000	90	5	7	85	7	Dhaka Metro GA 32-8332
Toyota Allion	2012	2008	2012	1500	219800	30000	80	5	5	75	6	Dhaka Metro GA 37-5121
Toyota Axio	2017	2015	2017	1500	43800	15000	50	2	8	48	7.5	Dhaka Metro GA 32-7217
Toyota Corolla X	2010	2001	2010	1500	175375	20000	50	2	7	48	6	Dhaka Metro GA 27-6365
Toyota Premio	2016	2012	2016	1500	87605	51000	40	2	7	38	7	Dhaka Metro GA 20-8579
Toyota Allion	2009	2005	2009	1500	313468	345000	80	5	6	75	6.5	Dhaka Metro GA 25-6857
Toyota Allion	2017	2014	2017	1500	86688	30000	100	5	8	95	8	Dhaka Metro GA 32-1740
Toyota Corolla X	2009	2006	2009	1500	236425	27000	60	5	6	55	6.5	Dhaka Metro GA 25-4354
Toyota Premio	2016	2012	2016	1500	108100	35000	80	5	7	75	6	Dhaka Metro GA 19-9378
Toyota Allion	2010	2008	2010	1500	263206	15000	80	5	7	75	7	Dhaka Metro GA 19-1632
Toyota Corolla X	2011	2008	2011	1500	133316	20000	40	2	7	38	6	Dhaka Metro GA 14-3087
Toyota Corolla X	2010	2005	2010	1500	197187	40000	50	2	6	48	6	Dhaka Metro GA 27-0342
Toyota Axio	2016	2010	2016	1500	92937	60000	35	2	7	33	6.5	Dhaka Metro GA 22-4260
Toyota Axio	2018	2015	2018	1500	73001	27000	50	2	8	48	8.5	Dhaka Metro GA 28-0110
Toyota Corolla X	2007	2003	2007	1500	458175	35000	100	5	6	95	6	Dhaka Metro GA 19-6083
Toyota Premio	2005	2003	2005	1500	509376	15000	100	10	7	90	7.5	Dhaka Metro GA 23-1927
Toyota Allion	2014	2010	2014	1500	93761	27000	40	2	7	38	8	Dhaka Metro GA 37-9566
Toyota Axio	2016	2012	2016	1500	72176	25000	50	2	7	48	7	Dhaka Metro GA 20-4494
Toyota Allion	2005	2003	2008	1500	170725	20000	30	2	7	28	8	Dhaka Metro GA 31-9818
Toyota Corolla X	2007	2004	2007	1500	128750	25000	25	3	6	22	6	Dhaka Metro GA 21-3221
Toyota Allion	2009	2005	2009	1500	368000	87600	85	4	6	81	9	Chatta Metro Ga 12-0278
Toyota Corolla X	2015	2010	2015	1500	45000	10000	24	1	7	23	8	Chatta Metro Ga 12-5026
Toyota Noah	2012	2010	2012	2000	75000	23900	20	1	7	19	10	Dhaka Metro Cha 15-9998
Toyota Corolla X	2008	2005	2008	1500	201000	34000	40	10	7	30	7	N/A
Toyota Axio	2012	2010	2012	1500	300000	45000	100	20	8	80	5.5	Chatta Metro Ga 12-0125
Toyota Corolla X	2011	2006	2011	1500	162238	15000	50	5	8	45	10	Dhaka Metro Ga21-8881
Succeed	2010	2004	2010	1500	99000	60000	12	2	7	10	8	Dhaka Metro Ga 23-4757
Toyota Corolla	2015	2014	2015	1500	60786	40	50	15	8	35	10	Dhaka Metro Ga 15- 5654
Toyota Axio	2015	2009	2015	1500	20000	15000	2	1	6	1	8	Chatta Metro Ka 13-0341
Mitsubishi Qx	2018	2016	2018	2000	11000	100	30	4	7	26	9	Dhaka Metro FA 18-2375
Toyota Allion	2012	2007	2012	1500	101000	20000	35	2	6	33	7	Chatta Metro Ga 12-6715
Toyota Allion	2016	2011	2016	1500	56730	26392	20	5	4	15	10	Dhaka Metro Ga 26-1528

Calculation of Fuel Consumption, Energy Consumption and GHG Emission Per Year (Gasoline)

$$M_{per\ year} = \frac{M_c - M_i}{Y_p - Y_r}$$

$$FC_{av,g} = \frac{M_{per\ year}}{FC_{rate}}$$

Energy consumption of gasoline per year = $FC_{av,g} \times 8.91667$ kWh

Average GHG emission per year for gasoline = $FC_{av,g} \times 2.157$ kg of CO_2

Car Model Name	Mileage (km)	Mileage Per Year (km/yr)	Average FC per year(L/yr)	Energy Consumption (kWh/yr)	GHG Emission(kg)
Toyota Premio	9000	3000	300	2675	647.136
Toyota Fielder	27000	2700	225	2006.25	485.352
Toyota Premio	2000	666.6666667	88.888889	792.5926	191.744
Nissan Xtrail	1000	1000	250	2229.1667	539.28
Toyota Premio	55000	11000	1466.6667	13077.778	3163.776
Toyota Premio	49000	12250	1361.1111	12136.574	2936.08
Toyota Prado	178274	7751.043478	1550.2087	13822.694	3343.9862
Toyota Allion	70730	7073	884.125	7883.4479	1907.1637
Toyota Premio	30000	7500	750	6687.5	1617.84
Toyota Allion	19600	3920	392	3495.3333	845.59104
Honda Insight (Hybrid)	41789	6964.833333	633.16667	5645.7361	1365.8165
Toyota Premio	32500	5416.666667	677.08333	6037.3264	1460.55
Toyota Allion	42800	8560	1070	9540.8334	2308.1184
Toyota Axio	52603	13150.75	1643.8438	14657.607	3545.9682
Honda Civic	70791	5056.5	722.35714	6441.0179	1558.211
Nissan Bluebird	39000	3900	487.5	4346.875	1051.596
Audi A8	74979	14995.8	3332.4	29713.9	7188.3867
Honda Vezel	350	350	29.166667	260.06945	62.916
Mitsubishi Outlander	47000	11750	3357.1429	29934.524	7241.76
Toyota Premio	89650	29883.33333	3735.4167	33307.465	8057.742
Toyota Axio	40000	10000	2857.1429	25476.191	6163.2
Mazda Axela	13620	13620	1513.3333	13493.889	3264.4416
Honda Vezel	22000	22000	1833.3333	16347.222	3954.72
Toyota Axio	65000	9285.714286	928.57143	8279.7619	2003.04
Toyota IST	74000	7400	740	6598.3334	1596.2688
Toyota Avanza	92000	18400	1840	16406.667	3969.1008
Hyundai Xcent	25000	8333.333333	925.92593	8256.1729	1997.3333
Toyota Fielder	5000	5000	500	4458.3334	1078.56
Toyota Premio	38672	4296.888889	716.14815	6385.6543	1544.8175
Toyota Fielder	55216	6135.111111	876.44444	7814.963	1890.5958
Toyota Vitz	12200	6100	677.77778	6043.5185	1462.048

Toyota Corolla X	119000	13222.22222	1469.1358	13099.794	3169.1022
Toyota Allion	40000	10000	1000	8916.6667	2157.12
Toyota Axio	48000	9600	1066.6667	9511.1111	2300.928
Toyota Probox	114255	9521.25	1057.9167	9433.0903	2282.0532
Toyota Premio	22000	3142.857143	392.85714	3502.9762	847.44
Mitsubishi Outlander	14959	7479.5	831.05556	7410.2454	1792.6866
Toyota Allion	67000	22333.33333	2791.6667	24892.361	6021.96
Toyota Aqua	15000	7500	750	6687.5	1617.84
Toyota Allion	54000	18000	2250	20062.5	4853.52
Mitsubishi Lancer	72000	12000	1500	13375	3235.68
Toyota Allion	38927	9731.75	1216.4688	10846.846	2624.0691
Toyota Premio	7740	7740	703.63636	6274.0909	1517.8281
Toyota Axio	73000	24333.33333	2433.3333	21697.222	5248.992
Toyota Yaris	48000	16000	2000	17833.333	4314.24
Toyota Premio	9972	3324	302.18182	2694.4546	651.84244
Toyota Axio	7000	2333.333333	291.66667	2600.6945	629.16
Toyota Chaser	133000	8312.5	1847.2222	16471.065	3984.68
Toyota Camry	204500	10225	1704.1667	15195.486	3676.092
Toyota Axio	40000	6666.666667	952.38095	8492.0635	2054.4
Toyota Premio	12500	12500	1562.5	13932.292	3370.5
Toyota Allion	19000	4750	593.75	5294.2709	1280.79
Toyota Premio	54900	54900	5490	48952.5	11842.589
Toyota Celica	5000	1666.666667	208.33333	1857.6389	449.4
Toyota Axio	300	300	33.333333	297.22222	71.904
Toyota Premio	670000	111666.6667	15952.381	142242.06	34411.2
Ssangyong Actyon	50000	6250	1785.7143	15922.619	3852
Toyota Corolla X	150000	12500	2083.3333	18576.389	4494
Toyota Axio	50000	10000	1000	8916.6667	2157.12
Toyota Corolla	19040	4760	595	5305.4167	1283.4864
Toyota Axio	40000	6666.666667	740.74074	6604.9383	1597.8667
Toyota Premio	19300	19300	3216.6667	28681.945	6938.736
Toyota Corolla X	25130	2792.222222	214.78632	1915.1781	463.31988
Honda CRV	73000	36500	9125	81364.584	19683.72
Toyota Allion	57225	5202.272727	472.93388	4216.9938	1020.1751
Honda Vezel	11945	2389	217.18182	1936.5379	468.48724
Toyota Carina	192700	12043.75	1505.4688	13423.763	3247.4768
Toyota Axio	23320	3331.428571	416.42857	3713.1548	898.2864
Ssangyong Korando	31250	10416.66667	1736.1111	15480.324	3745
Toyota Rush	33000	3300	471.42857	4203.5714	1016.928
Toyota Premio	33300	8325	756.81818	6748.2955	1632.5476
Toyota Allion	10950	3650	365	3254.5833	787.3488
Toyota Estima	547345	68418.125	13683.625	122012.32	29517.221
Toyota Vitz	24000	6000	750	6687.5	1617.84
Toyota Axio	20000	10000	1428.5714	12738.095	3081.6
Toyota Allion	65771	6577.1	939.58571	8377.9727	2026.7991

Toyota Corolla X	66224	7358.222222	919.77778	8201.3519	1984.071
Toyota Allion	44099	6299.857143	1049.9762	9362.2877	2264.9246
Toyota Noah Hybrid	36600	18300	1830	16317.5	3947.5296
Hyundai Kia	37300	5328.571429	1184.127	10558.466	2554.304
Toyota Fielder	18574	18574	2321.75	20702.271	5008.2934
Nissan Xtrail	8250	4125	825	7356.25	1779.624
Toyota Axio	11716	11716	1464.5	13058.458	3159.1022
Toyota Axio	9880	9880	1235	11012.083	2664.0432
Toyota Allion	19795	19795	3299.1667	29417.57	7116.6984
Toyota Noah	59664	14916	3314.6667	29555.778	7150.1338
Toyota Allion	116700	10609.09091	1178.7879	10510.859	2542.7869
Toyota Premio	67729	9675.571429	1382.2245	12324.835	2981.6241
Toyota Allion	101887	9262.454545	1234.9939	11012.029	2664.0301
Toyota Premio	67886	5657.166667	942.86111	8407.1783	2033.8646
Toyota Fielder	199650	22183.33333	3169.0476	28257.341	6836.016
Toyota Corolla X	3544	3544	393.77778	3511.1852	849.42592
Mitsuibishi Outlander	3175	1587.5	317.5	2831.0417	684.8856
Toyota Axio	119924	39974.66667	3634.0606	32403.707	7839.1048
Toyota Harrier	29413	29413	5347.8182	47684.712	11535.886
Toyota Allion	107312	9755.636364	2438.9091	21746.939	5261.0196
Toyota Corolla X	210783	11710.16667	1463.7708	13051.957	3157.5293
Toyota Premio	14600	14600	2085.7143	18597.619	4499.136
Toyota Corolla X	470980	23549	3924.8333	34996.431	8466.3365
Nissan Selero	60679	4334.214286	1238.3469	11041.927	2671.2629
Toyota Premio	115427	19237.83333	3206.3056	28589.558	6916.3858
Toyota Noah	8000	8000	1600	14266.667	3451.392
Toyota Premio	19850	4962.5	620.3125	5531.1198	1338.0885
Toyota Vitz	40427	13475.66667	1684.4583	15019.754	3633.5788
Toyota Premio	661308	66130.8	11021.8	98277.717	23775.345
Toyota Axio	167752	16775.2	2795.8667	24929.811	6031.0199
Toyota Corolla X	88623	8862.3	1107.7875	9877.7719	2389.6306
Toyota Allion	14048	4682.666667	468.26667	4175.3778	1010.1074
Toyota Allion	37061	12353.66667	1372.6296	12239.281	2960.9268
Mitsubishi Asx 19	6842	6842	1368.4	12201.567	2951.803
Honda Vezel	23810	11905	1488.125	13269.115	3210.0642
Toyota Premio	14000	4666.666667	466.66667	4161.1111	1006.656
Honda 2014	33646	8411.5	841.15	7500.2542	1814.4615
Toyota Allion	297680	27061.81818	5412.3636	48260.243	11675.118
Toyota Premio	11539	5769.5	721.1875	6430.5886	1555.688
Toyota Ractis 2012	14722	7361	736.1	6563.5584	1587.856
Toyota Allion	14347	14347	1793.375	15990.927	3868.5251
Mercedes S320	91073	18214.6	3035.7667	27068.92	6548.513
Toyota Allion	200768	18251.63636	2607.3766	23249.108	5624.4243
Toyota Premio	46460	5807.5	829.64286	7397.6488	1789.6392
Toyota Allion	13311	4437	369.75	3296.9375	797.59512

Toyota Allion	255500	18250	2281.25	20341.146	4920.93
Toyota Allion	39043	7808.6	1115.5143	9946.6691	2406.2982
Toyota Corolla X	58400	14600	1825	16272.917	3936.744
Toyota Starline	21046457	1052322.85	131540.36	1172901.5	283748.33
Mercedes E Class	9672	4836	1209	10780.25	2607.9581
Toyota Premio	57457	11491.4	1436.425	12808.123	3098.5411
Toyota Premio	91250	18250	2281.25	20341.146	4920.93
Toyota Premio	6720	6720	840	7490	1811.9808
Toyota Premio	7300	3650	331.81818	2958.7121	715.77164
Toyota Premio	48200	5355.555556	892.59259	7958.9506	1925.4293
Nissan Xtrail	9125	9125	1825	16272.917	3936.744
Toyota Allion	35600	7120	890	7935.8334	1919.8368
Toyota Axio	87600	21900	3128.5714	27896.429	6748.704
Toyota Axio	21000	21000	3000	26750	6471.36
Audi A3	27016	27016	2701.6	24089.267	5827.6754
Toyota Vitz	14300	7150	1021.4286	9107.7381	2203.344
Toyota Vitz	17425	8712.5	1452.0833	12947.743	3132.318
Toyota Axio	60938	12187.6	2031.2667	18112.128	4381.686
Hyundai	54750	18250	3041.6667	27121.528	6561.24
Toyota Premio	39325	19662.5	2457.8125	21915.495	5301.7965
Toyota Premio	18704	18704	2338	20847.167	5043.3466
Toyota Axio	18868	18868	2695.4286	24034.238	5814.3629
Toyota Axio	14401	14401	1800.125	16051.115	3883.0856
Toyota Premio	127750	31937.5	3992.1875	35597.005	8611.6275
Toyota Premio	14600	14600	1622.2222	14464.815	3499.328
Toyota Premio	7300	7300	912.5	8136.4584	1968.372
Toyota Premio	45800	45800	5088.8889	45375.926	10977.344
Toyota Premio	21900	21900	2433.3333	21697.222	5248.992
Toyota Premio	19900	9950	1243.75	11090.104	2682.918
Toyota Allion	6509	3254.5	325.45	2901.9292	702.0347
BMW	2000	2000	250	2229.1667	539.28
Mitsubishi Outlander	52000	13000	2166.6667	19319.445	4673.76
Toyota Axio	14600	7300	912.5	8136.4584	1968.372
Toyota Axio	156000	17333.33333	1733.3333	15455.556	3739.008
Mitsubishi Outlander	13400	13400	1340	11948.333	2890.5408
Toyota Premio	15441	7720.5	857.83333	7649.0139	1850.4494
Toyota Premio	13300	6650	950	8470.8334	2049.264
Toyota Noah	11000	11000	1571.4286	14011.905	3389.76

Calculation of Fuel Consumption, Energy Consumption and GHG Emission Per Year (Bi-Fuel)

$$FC_{av_1} = \frac{M_{per\ year}}{FC_{rate,g}}$$

$$FC_{av_2} = \frac{D_g}{D_T} \times \frac{M_{per\ year}}{FC_{rate,g}}$$

$$FC_{av,g} = \frac{FC_{av_1} \times (Y_c - Y_r) + FC_{av_2} \times (Y_p - Y_c)}{Y_p - Y_r}$$

$$FC_{av,CNG} = \frac{D_{CNG}}{D_T} \times \frac{M_{per\ year}}{FC_{rate,CNG}}$$

Energy conversion of CNG per year = $FC_{av,CNG} \times 10.611$ kWh

Average GHG emission per year of CNG = $FC_{av,CNG} \times 1.92$ kg of CO_2

		For Oil						For CNG			
Car Model Name	**Mileage**	**Mileage Per Year (km/yr)**	**Mileage by Oil, Pre Conv.(L/yr1)**	**Mileage by Oil, Pro Conv.(L/yr2)**	**Average FC per year(L/yr)**	**Energy Consumption (kWh/yr)**	**GHG Emission(kg)**	**Mileage by CNG (km/yr)**	**Average FC per year(m3/yr)**	**Energy Consumption (kWh/yr)**	**GHG Emission(kg)**
Toyota Premio	135000	10384.61538	1483.516484	247.2527473	247.25275	2204.670338	533.3538462	13500	1928.571429	20464.07143	3702.857143
Toyota Allion	47000	3615.384615	451.9230769	15.58355438	59.217507	528.0227694	127.7392679	10966.66667	1566.666667	16623.9	3008
Toyota Probox	104000	5777.777778	825.3968254	55.02645503	165.07937	1471.957677	356.096	16250	2166.666667	22990.5	4160
Toyota Corolla X	307815	21986.78571	2198.678571	586.3142857	586.31429	5227.969067	1264.750272	46172.25	7695.375	81655.62413	14775.12
Toyota Premio	31000	7750	775	387.5	387.5	3455.208346	835.884	18600	2066.666667	21929.4	3968
Toyota Axio	104000	14857.14286	1485.714286	99.04761905	99.047619	883.1746065	213.6576	10400	1300	13794.3	2496
Toyota Tercel	177000	8045.454545	804.5454545	27.74294671	301.90854	2692.017805	651.2529449	41300	5900	62604.9	11328
Toyota Corolla X	163243	10882.86667	1554.695238	53.61018062	169.07826	1507.614508	364.7221005	21765.73333	2720.716667	28869.52455	5223.776
Toyota Corolla Sprinter	260203	12390.61905	1770.088435	1180.058957	1366.3841	12183.59121	2947.454374	104081.2	13010.15	138050.7017	24979.488
Toyota Axio	81000	6230.769231	623.0769231	155.7692308	214.18269	1909.79568	462.0177692	22680	3240	34379.64	6220.8
Toyota Axio	19000	3166.666667	527.7777778	81.1965812	81.196581	724.0028517	175.1507692	8866.666667	1266.666667	13440.6	2432
Toyota Corolla X	173000	13307.69231	2217.948718	116.734143	350.20243	3122.638338	755.428664	30275	4325	45892.575	8304
Toyota Corolla X	78000	5571.428571	557.1428571	25.91362126	25.913621	231.0631238	55.89879007	13866.66667	1733.333333	18392.4	3328
Toyota Corolla X	171000	10687.5	1526.785714	109.0561224	109.05612	972.4170955	235.2471429	34200	5700	60482.7	10944
Toyota Corolla	96465	2923.181818	417.5974026	83.51948052	313.91805	2799.1026	677.1588986	96465	16077.5	170598.3525	30868.8
Toyota Allion	48000	3692.307692	527.4725275	105.4945055	105.49451	940.6593442	227.5643077	28000	4000	42444	7680
Toyota 90	397000	13689.65517	1955.665025	217.2961138	1260.3175	11237.83073	2718.656	55580	7940	84251.34	15244.8
Toyota Allion	129440	11767.27273	1810.34965	319.4734677	319.47347	2848.638431	689.1426067	38832	6472	68674.392	12426.24
Toyota Premio	105000	6562.5	1093.75	437.5	546.875	4876.302102	1179.675	90000	15000	159165	28800
Toyota Axio	51000	10200	1700	52.57731959	52.57732	468.8144347	113.4155876	4080	510	5411.61	979.2

Toyota Fielder	80000	6666.666667	833.3333333	166.6666667	250	2229.166675	539.28	46666.66667	6666.666667	70740	12800
Toyota Fielder	115000	8214.285714	821.4285714	43.23308271	43.233083	385.4949889	93.25894737	40250	5750	61013.25	11040
Toyota Axio	199855	18168.63636	2018.737374	118.7492573	809.65403	7219.4151	1746.520895	17764.88889	2220.611111	23562.9045	4263.573333
Toyota Premio	41000	4555.555556	506.1728395	56.24142661	56.241427	501.4860558	121.3195062	16400	2050	21752.55	3936
Toyota Allion	83723	5581.533333	930.2555556	66.4468254	152.8277	1362.713649	329.6676848	19535.36667	2790.766667	29612.8251	5358.272
Toyota Corolla X	115000	8846.153846	1474.358974	163.8176638	163.81766	1460.707508	353.374359	46000	5750	61013.25	11040
Toyota Corolla X	142000	10923.07692	1456.410256	60.68376068	370.8452	3306.703083	799.9576068	17040	2840	30135.24	5452.8
Toyota Corolla X	44113	2757.0625	459.5104167	62.66051136	98.737775	880.4118347	212.9892302	10587.12	1764.52	18723.32172	3387.8784
Toyota Corolla X	152000	10133.33333	2026.666667	106.6666667	106.66667	951.1111147	230.0928	45600	7600	80643.6	14592
Toyota Corolla X	197523	15194.07692	1899.259615	79.13581731	261.1482	2328.571433	563.327999	27653.22	3950.46	41918.33106	7584.8832
Toyota Corolla	222378	11118.9	3706.3	264.7357143	264.73571	2360.560128	571.066704	103776.4	14825.2	157310.1972	28464.384
Toyota Corolla GLI	95000	5937.5	989.5833333	197.9166667	367.55952	3277.405766	792.87	13300	1900	20160.9	3648
Mitsubishi Pajero	85000	3400	566.6666667	53.125	335.57292	2992.191851	723.87105	14571.42857	2428.571429	25769.57143	4662.857143
Toyota Carina	549980	19642.14286	2806.020408	130.5125771	1579.746	14086.06842	3407.70166	109996	12221.77778	129685.284	23465.81333
Toyota Corolla X	54123	3865.928571	552.2755102	110.455102	-110.4551	-984.8913302	-238.2649097	40592.25	4510.25	47858.26275	8659.68
Toyota Corolla 110	250500	10891.30435	1555.900621	212.1682665	707.22756	6306.112389	1525.574704	80160	10020	106322.22	19238.4
Toyota Corona	186348	8102.086957	1350.347826	71.07093822	582.78169	5196.470119	1257.130046	27952.2	4658.7	49433.4657	8944.704
Toyota Corolla	85000	3269.230769	408.6538462	81.73076923	196.15385	1749.038468	423.1273846	28333.33333	3541.666667	37580.625	6800
Toyota 100	163000	6269.230769	835.8974359	59.70695971	377.23943	3363.718239	813.7507133	32600	5433.333333	57653.1	10432
Toyota 111	80000	2962.962963	493.8271605	123.4567901	316.69351	2823.850431	683.1458937	112000	16000	169776	30720
Toyota Corsa	33000	1137.931034	113.7931034	37.93103448	80.076628	714.0166055	172.7348966	11550	1650	17508.15	3168
Toyota Premio	89000	11125	1589.285714	529.7619048	529.7619	4723.710335	1142.76	26700	4450	47218.95	8544
Toyota Corolla	45000	2647.058824	330.8823529	14.18067227	14.180672	126.4443282	30.58941176	2475	450	4774.95	864
Toyota Premio	31000	3444.444444	1148.148148	287.037037	287.03704	2559.41359	619.1733333	14466.66667	2066.666667	21929.4	3968
Toyota Probox	110567	6910.4375	1151.739583	127.9710648	127.97106	1141.075332	276.0489433	22113.4	2211.34	23464.52874	4245.7728
Toyota Corolla	70000	4375	729.1666667	52.08333333	142.36111	1269.386579	307.09	28000	4666.666667	49518	8960
Toyota Corolla X	105500	7535.714286	941.9642857	32.48152709	32.481527	289.626951	70.06655172	35166.66667	3516.666667	37315.35	6752
Toyota Fielder	47000	5875	839.2857143	34.97023801	34.970238	311.8179575	75.435	7520	940	9974.34	1804.8
Toyota Noah	38097	2381.0625	396.84375	99.21093705	99.210938	884.6308627	214.0098975	20953.35	3809.7	40424.7267	7314.624
Toyota Corona	99200	3674.074074	459.2592593	51.02880658	51.028807	455.0068604	110.0752593	49600	4960	52630.56	9523.2
Toyota Fielder	63000	7000	875	50	50	445.833335	107.856	11025	1575	16712.325	3024
Toyota AE111	110000	5000	833.3333333	21.36752137	260.181	2319.947218	561.241629	16500	2750	29180.25	5280
Toyota Allion	148750	10625	1770.833333	49.18981481	49.189815	438.6091837	106.1083333	22111.48649	4020.27027	42659.08784	7718.918919
Toyota Fielder	300000	18750	1562.5	669.6428571	669.64286	5970.982165	1444.5	105000	15000	159165	28800
Toyota Corolla X	399800	21042.10526	3006.015038	601.2030075	1202.406	10721.45367	2593.734063	79960	13326.66667	141409.26	25587.2
Toyota Axio	119000	14875	2975	330.5555556	330.55556	2947.453715	713.048	38675	5950	63135.45	11424
Toyota Corolla X	98550	6570	1010.769231	112.3076923	212.13675	1891.552714	457.6044308	26280	3285	34857.135	6307.2
Toyota Allion	21900	1990.909091	398.1818182	99.54545455	99.54545	887.6136397	214.7314909	12045	2190	23238.09	4204.8

Toyota Premio	74499	18624.75	2069.416667	689.8055556	689.80556	6150.766227	1487.99336	93123.75	9312.375	98813.61113	17879.76
Toyota Premio	66000	4714.285714	471.4285714	157.1428571	419.04762	3736.50795	903.936	9900	1650	17508.15	3168
Toyota 100	195965	8520.217391	1065.027174	31.32432864	289.75004	2583.604533	625.0256062	25195.5	2799.5	29705.4945	5375.04
Toyota Corolla X	195200	13013.33333	1626.666667	147.8787879	147.87879	1318.585864	318.9922909	19520	3253.333333	34521.12	6246.4
Toyota Premio	41216	4579.555556	654.2222222	34.43274854	34.43274	307.0253423	74.27557053	7212.8	1030.4	10933.5744	1978.368
Toyota Corolla X	175503	12535.92857	1790.846939	145.2038058	398.37967	3552.218759	859.352759	28519.2375	4387.575	46556.55833	8424.144
Toyota Allion	65698	4106.125	684.3541667	45.62361111	45.62361	406.8105339	98.415604	32849	4106.125	43570.09238	7883.76
Toyota Allion	112550	12505.55556	1563.194444	31.90192744	31.90192	284.458854	68.81628571	11255	1125.5	11942.6805	2160.96
Toyota Axio	120074	10006.16667	1250.770833	138.974537	138.97454	1239.189627	299.7847533	9005.55	1500.925	15926.31518	2881.776
Toyota Warrior	9344	718.7692308	102.6813187	8.325512326	15.58365	138.9542244	33.61580584	1401.6	233.6	2478.7296	448.512
Toyota Vios	391745	23043.82353	2880.477941	180.0298713	180.0298	1605.266359	388.346036	230438.2353	23043.82353	244518.0115	44244.14118
Toyota Noah	133683	19097.57143	2387.196429	265.2440476	265.24405	2365.092767	572.16324	11363.055	1336.83	14185.10313	2566.7136
Toyota Fielder	116000	16571.42857	2367.346939	85.8623242	85.86324	765.605727	185.2153368	3480	580	6154.38	1113.6
Toyota Axio	80373	6697.75	1488.388889	228.982906	228.98291	2041.764253	493.9436062	10716.4	1339.55	14213.96505	2571.936
Toyota Corolla X	265000	18928.57143	3154.761905	286.7965368	286.79654	2557.269129	618.6545455	35333.33333	4416.666667	46865.25	8480
Toyota Premio	72000	5538.461538	923.0769231	263.7362637	263.73626	2351.64836	568.9107692	14400	1600	16977.6	3072
Toyota Corolla X	32647	2511.307692	251.1307692	62.78269231	62.78269	559.8123418	135.4298012	26117.6	3264.7	34641.7317	6268.224
Toyota Fielder	54700	6837.5	854.6875	61.04910714	61.04910	544.3545407	131.69025	7293.333333	729.3333333	7738.956	1400.32
Toyota Premio	87594	8759.4	625.6714286	48.12857143	48.12857	429.1464302	103.819104	10010.74286	1251.342857	13277.99906	2402.578286
Toyota Allion	66947	16736.75	1673.675	34.15663265	34.15663	304.563309	73.67995543	6025.23	669.47	7103.74617	1285.3824
Toyota Allion	51100	8516.666667	1216.666667	304.1666667	304.16667	2712.152788	656.124	6205	730	7746.03	1401.6
Toyota Premio	41525	4613.888889	659.1269841	107.2997416	107.29974	956.7560329	231.4584186	4983	830.5	8812.4355	1594.56
Toyota Allion	31469	2247.785714	374.6309524	31.21924603	31.21924	278.3716115	67.34366	15734.5	2420.692308	25685.96608	4647.729231
Toyota Fielder	21580	2697.5	449.5833333	15.50287356	15.50287	138.2339565	33.44155862	2158	359.6666667	3816.423	690.56
Toyota Fielder	75500	8388.888889	1398.148148	84.73625174	84.73625	755.5649112	182.7862626	7550	1078.571429	11444.72143	2070.857143
Toyota Allion	1039049	64940.5625	10823.42708	1202.603009	3006.5075	26808.02551	6485.397508	187028.82	20780.98	220506.9788	39899.4816
Toyota Corolla	175145	11676.33333	1946.055556	49.89886004	456.21815	4067.945206	984.1173005	52543.5	8757.25	92923.17975	16813.92
Toyota Premio	45336	5037.333333	719.6190476	179.9047619	179.90476	1604.1508	388.07616	36268.8	4533.6	48106.0296	8704.512
Toyota Avanza	24000	4000	571.4285714	23.80952381	23.80952	212.3015881	51.36	3360	480	5093.28	921.6
Toyota Cabina	185271	13233.64286	1890.520408	78.77168367	467.00355	4164.115032	1007.382705	62992.14	7410.84	78636.42324	14228.8128
Toyota Corolla	102200	6387.5	1064.583333	56.03070175	200.10965	1784.311045	431.6605263	33215	5110	54222.21	9811.2
Toyota Corolla X	88000	5500	1100	73.33333333	347.11111	3095.074086	748.76032	38500	5500	58360.5	10560
Toyota Axio	145545	10396.07143	866.3392857	216.5848214	216.58482	1931.214665	467.19945	13099.05	1455.45	15443.77995	2794.464
Toyota Noah	265309	14739.38889	2947.877778	101.6509579	320.59148	2858.607396	691.5542987	28741.80833	4421.816667	46919.89665	8489.888
Toyota Axio	157200	11228.57143	1604.081633	62.49668699	62.49668	557.2621277	134.8128534	11790	1965	20850.615	3772.8
Toyota Noah	180885	11305.3125	2826.328125	256.9389205	256.93892	2291.038716	554.2480841	25625.375	3014.75	31989.51225	5788.32
Toyota Harrier	305719	21837.07143	4852.682504	808.7804233	1430.9192	12759.02967	3086.664447	26204.48571	4367.414286	46342.63299	8385.435429
Toyota Fielder	167090	9828.823529	1638.137255	86.21775026	307.92054	2745.624795	664.221548	50127	8354.5	88649.5995	16040.64
Toyota Fielder	37539	5362.714286	766.1020408	287.2882653	287.28827	2561.653709	619.7152629	1876.95	341.2636364	3621.148445	655.2261818
Toyota Allion	79562	6630.166667	736.6851852	64.05958132	64.05958	571.1979356	138.1842041	12729.92	1591.24	16884.64764	3055.1808

Toyota Fielder	90838	12976.85714	2595.371429	288.3746032	288.3746	2571.340221	622.058624	10900.56	1816.76	19277.64036	3488.1792
Toyota Corona	2398512	88833.77778	14805.62963	688.6339363	8335.3399	74323.44805	17980.32848	213201.0667	26650.13333	282784.5648	51168.256
Toyota Allion	50749	6343.625	975.9423077	62.29418985	62.29419	555.4565283	134.3760428	9134.82	1014.98	10769.95278	1948.7616
Toyota Allion	2658	332.25	60.40909091	20.13636364	20.13636	179.5492431	43.43655273	3987	664.5	7051.0095	1275.84
Toyota Raum	81000	4050	578.5714286	18.36734694	117.22689	1045.273113	252.8724706	8723.076923	1246.153846	13222.93846	2392.615385
Toyota Corolla	359017	29918.08333	3739.760417	747.9520833	747.95208	6669.239435	1613.422398	29918.08333	2991.808333	31746.07823	5744.272
Toyota Allion	47796	5310.666667	1062.133333	118.0148148	118.01481	1052.298769	254.5721173	9559.2	1593.2	16905.4452	3058.944
Toyota Tercel	27000	1227.272727	122.7272727	12.27272727	44.75935	399.1042796	96.55130695	10431.81818	1227.272727	13022.59091	2356.363636
Toyota Corolla X	121000	8642.857143	1234.693878	51.44557823	51.44557	458.7230743	110.9742857	12100	2420	25678.62	4646.4
Toyota Axio	9547	1060.777778	106.0777778	35.35925926	35.35925	315.2867296	76.27416533	7160.25	1193.375	12662.90213	2291.28
Toyota Prado	143840	11986.66667	2996.666667	332.962963	332.96296	2968.919764	718.2410667	35960	3596	38157.156	6904.32
Toyota Corolla X	382403	15296.12	2185.16	128.5388235	128.53882	1146.137847	277.273667	33991.37778	4248.922222	45085.3137	8157.930667
Toyota Corolla X	128103	5124.12	854.02	94.89111111	94.89111	846.1124106	204.6915136	19215.45	2135.05	22655.01555	4099.296
Toyota Premio	116800	7786.666667	973.3333333	51.22807018	51.22807	456.7836274	110.5050947	23360	2920	30984.12	5606.4
Toyota Corolla X	140809	5632.36	804.6228571	61.89406593	61.89406	551.8887566	133.5129275	17098.23571	2011.557143	21344.63284	3862.189714
Toyota Corolla X	307112	12284.48	2456.896	272.9884444	272.98844	2434.146972	588.8688333	18426.72	3071.12	32587.65432	5896.5504
Toyota Corolla X	60593	2423.72	302.965	7.768333333	7.768333	69.26763915	16.757227 2	6059.3	757.4125	8036.904038	1454.232
Toyota Corolla X	293834	11753.36	1958.893333	326.4822222	326.48222	2911.133159	704.2613312	31482.21429	4197.628571	44541.036 77	8059.446857
Toyota Corolla X	65700	2628	525.6	37.54285714	37.54285	334.7571441	80.984448	10950	2190	23238.09	4204.8
Toyota Premio	51742	4311.833333	479.0925926	53.23251029	53.23251	474.6565518	114.8289126	8278.72	1034.84	10980.68724	1986.8928
Toyota Corolla X	410519	16420.76	1642.076	182.4528889	182.45289	1626.871599	393.5727757	41051.9	4105.19	43560.17109	7881.9648
Toyota Prado	267742	12170.09091	3477.168831	144.8820346	1021.7996	9111.04658	2204.14438	32129.04	5354.84	56820.20724	10281.2928
Toyota Corolla	1268752	63437.6	12687.52	906.2514286	3524.3111	31425.10752	7602.361984	174453.4	31718.8	336568.1868	60900.096
Toyota Corolla X	36868	2633.428571	526.6857143	131.6714286	131.67143	1174.070242	284.031072	14747.2	2457.866667	26080.4232	4719.104
Toyota Corolla X	219000	14600	2433.333333	83.90804598	83.90804	748.1800794	180.9997241	32850	3650	38730.15	7008
Toyota Allion	26568	1660.5	237.2142857	15.14133739	15.14133	135.0102589	32.661681 7	3453.84	531.36	5638.26096	1020.2112
Toyota Premio	346414	21650.875	4330.175	168.7081169	1060.451	9455.688301	2287.520105	30311.225	4330.175	45947.48693	8313.936
Toyota Probox	654999	43666.6	4366.66	99.24227273	99.24227	884.9102685	214.0774913	27291.625	3638.883333	38612.19105	6986.656
Toyota Allion	201062	13404.13333	1675.516667	69.81319444	69.81319	622.5009861	150.595438	24127.44	4021.24	42669.37764	7720.7808
Toyota Noah	256470	18319.28571	2617.040816	137.7389903	137.73899	1228.172668	297.1195308	14105.85	2564.7	27214.0317	4924.224
Toyota Corolla X	384107	24006.6875	3000.835938	157.9387336	157.93873	1408.287046	340.6928009	28808.025	4801.337 5	50946.99221	9218.568
Toyota Axio	54000	9000	1500	78.94736842	78.94736	703.9473711	170.2989474	3240	540	5729.94	1036.8
Toyota Corolla	78800	5253.333333	583.7037037	22.74170274	22.74170	202.7801835	49.05658182	7880	985	10451.835	1891.2
Toyota Noah	105200	11688.88889	1298.765432	105.3053053	105.30531	938.9723091	227.1561802	15780	2630	27906.93	5049.6
Toyota Axio	54750	6083.333333	760.4166667	66.12318841	66.12318	589.5984322	142.6356522	8212.5	1095	11619.045	2102.4
Toyota Allion	78000	5571.428571	928.5714286	48.87218045	48.87218	435.776944	105.4231579	11700	1950	20691.45	3744
Toyota Premio	56500	7062.5	882.8125	23.23190789	23.23190	207.1511795	50.11401316	10141.02564	1448.717949	15372.34615	2781.538462
Toyota Allion	229950	32850	5475	124.4318182	124.43182	1109.51705	268.4143636	12775	2555	27111.105	4905.6

Toyota Allion	32850	6570	938.5714286	32.36453202	32.364532	288.5837449	69.81417931	8760	1095	11619.045	2102.4
Toyota Premio	40919	5114.875	1022.975	45.80485075	45.80485	408.4265873	98.80655964	3507.342857	584.5571429	6202.735843	1122.349714
Toyota Corolla X	154916	11065.42857	1580.77551	70.25668934	70.25668	626.4554823	151.5521097	26368.68085	3296.085106	34974.759 06	6328.483404
Toyota Noah	281050	18736.66667	3122.777778	139.8258706	139.8258	1246.780685	301.6211821	24090	4015	42603.165	7708.8
Toyota Premio	281050	18736.66667	3122.777778	117.8406709	117.8406	1050.745986	254.1964679	28105	5110	54222.21	9811.2
Toyota Corolla X	148767	10626.21429	1518.030612	42.16751701	42.16751	375.9936947	90.96039429	20103.64865	4020.72973	42663.963 16	7719.801081
Toyota Corona	91250	3258.928571	543.1547619	60.3505291	292.0965	2604.527677	630.0873333	63875	9125	96825.375	17520
Toyota Corolla X	164250	14931.81818	2488.636364	103.6931818	103.6931	924.5975413	223.6786364	26280	3285	34857.135	6307.2
Toyota Axio	36500	5214.285714	869.047619	36.21031746	36.21031	322.8753319	78.11	5110	730	7746.03	1401.6
Toyota Axio	58400	9733.333333	1081.481481	27.730294	27.73029	247.2617926	59.81757265	3650	730	7746.03	1401.6
Toyota Allion	72000	4500	750	39.47368421	39.47368	351.9736855	85.14947368	12600	1800	19099.8	3456
Toyota Corolla X	182500	13035.71429	2607.142857	289.6825397	289.6825	2583.002655	624.88	21900	3650	38730.15	7008
Toyota Premio	262000	18714.28571	3119.047619	222.7891156	222.7891	1986.536289	480.5828571	32750	4366.666667	46334.7	8384
Toyota Axio	197100	16425	2737.5	248.8636364	248.8636	2219.034099	536.8287273	21352.5	3285	34857.135	6307.2
Toyota Axio	164000	13666.66667	2277.777778	94.90740741	94.90740	846.2577192	204.7266667	29520	3280	34804.08	6297.6
Toyota Corolla X	102536	6835.733333	854.4666667	94.94074074	94.94074	846.5549414	204.7985707	16405.76	2050.72	21760.189 92	3937.3824
Toyota Corolla X	246877	14522.17647	2074.596639	86.44152661	86.44152	770.7702818	186.4647459	32094.01	4937.54	52392.236 94	9480.0768
Toyota Feilder	416107	29721.92857	4245.989796	385.9990724	385.9990	3441.825075	832.646319	24272.90833	3467.558333	36794.261 48	6657.712
Toyota Noah	16873	2410.428571	301.3035714	21.52168367	21.52168	191.9016801	46.42485429	4780.683333	562.4333333	5967.9801	1079.872
Toyota Feilder	466275	46627.5	6661.071429	475.7908163	475.7908	4242.468128	1026.337886	24868	3108.5	32984.293 5	5968.32
Toyota Feilder	276050	27605	3450.625	181.6118421	181.6118	1619.372265	391.7585368	19323.5	2760.5	29291.665 5	5300.16
Toyota Premio	307453	20496.86667	2928.12381	195.208254	195.2082	1740.606938	421.0876288	26902.1375	3843.1625	40779.797 29	7378.872
Toyota Noah	603954	31787.05263	5297.842105	278.833795	1164.541	10383.82524	2512.054992	42276.78	6039.54	64085.558 94	11595.9168
Toyota Corolla X	639648	35536	5076.571429	267.1879699	1335.9398	11912.13037	2881.782568	38378.88	6396.48	67873.049 28	12281.2416
Toyota Corolla X	120226	8587.571429	1226.795918	87.62827988	87.62828	781.3521652	189.0247151	20037.66667	4007.533333	42523.936 2	7694.464
Toyota Corolla X	127161	9082.928571	1513.821429	79.67481203	79.67481	710.4337433	171.8681305	25432.2	3179.025	33732.634 28	6103.728
Toyota Allion	77683	9710.375	1387.196429	126.1087662	126.1087	1124.469836	272.0317418	7768.3	1294.716667	13738.238 55	2485.856
Toyota Corolla X	216608	16662.15385	3332.430769	175.3910931	175.3910	1563.903919	378.3396348	16245.6	2166.08	22984.274 88	4158.8736
Toyota Axio	51367	5707.444444	951.2407407	39.63503086	39.63503	353.4123599	85.49751778	7191.38	1027.34	10901.104 74	1972.4928
Toyota Premio	142460	15828.88889	2261.269841	66.50793651	66.50793	593.0291027	143.4656	13228.42857	2035.142857	21594.900 86	3907.474286
Toyota Premio	69550	6322.727273	903.2467532	47.5393028	47.53930	423.8921182	102.5479809	24342.5	3477.5	36899.752 5	6676.8
Toyota Corolla X	256573	19736.38462	3947.276923	263.1517949	263.1517	2346.436846	567.6499998	22450.1375	3207.1625	34031.201 29	6157.752
Toyota Corolla X	203609	13573.93333	1939.133333	80.79722222	80.79722	720.4419008	174.289304	30541.35	4072.18	43209.901 98	7818.5856
Toyota Allion	105506	11722.88889	1674.698413	111.6465608	111.6465	995.5151713	240.8350293	7912.95	1318.825	13994.052 08	2532.144
Toyota Allion	44900	8980	1282.857143	116.6233766	116.6233	1039.891779	251.5706182	2993.333333	374.1666667	3970.2825	718.4
Toyota Corolla X	288162	20583	2572.875	88.71982759	88.71982	791.0851323	191.3793145	28816.2	4802.7	50961.449 7	9221.184
Toyota Corolla X	128850	9203.571429	1314.795918	69.19978518	69.19978	617.0314201	149.2722406	22548.75	3221.25	34180.683 75	6184.8

Toyota Corolla X	194125	17647.72727	2521.103896	168.0735931	168.07359	1498.656211	362.5549091	16985.9375	2426.5625	25748.25469	4659
Toyota Allion	173927	12423.35714	2070.559524	86.27331349	86.27331	769.2703815	186.10189	24349.78	3478.54	36910.78794	6678.7968
Toyota Corolla X	173800	6952	1390.4	99.31428571	260.7	2324.575009	562.361184	31863.33333	5793.333333	61473.06	11123.2
Toyota Corolla X	214175	19470.45455	3245.075758	190.8868093	190.88681	1702.074056	411.765754	15468.19444	2379.722222	25251.2325	4569.066667
Toyota Corolla X	314362	19647.625	3929.525	163.7302083	163.73021	1459.927696	353.185707	29340.45333	4191.493333	44475.93576	8047.6672
Toyota Axio	217450	15532.14286	2588.690476	199.1300366	199.13004	1775.576167	429.5473846	18638.57143	3106.428571	32962.31357	5964.342857
Toyota Axio	49389	7055.571429	1007.938776	71.99562682	71.99562	641.9610082	155.3032065	12347.25	1646.3	17468.8893	3160.896
Toyota Allion	66938	7437.555556	929.6944444	38.73726852	38.73726	345.4073122	83.56093667	10710.08	1338.76	14205.58236	2570.4192
Toyota Axio	62300	8900	1112.5	101.1363636	101.13636	901.7992458	218.1632727	7268.333333	1038.333333	11017.755	1993.6
Toyota Corolla X	45725	2857.8125	476.3020833	19.84592014	19.8459	176.9594552	42.81003125	5487	914.5	9703.7595	1755.84
Toyota Corolla X	156125	13010.41667	1858.630952	206.5145503	206.51455	1841.421413	445.4766667	24980	3122.5	33132.8475	5995.2
Toyota Axio	189900	21100	3014.285714	200.952381	200.95238	1791.825404	433.4784	16616.25	2373.75	25187.86125	4557.6
Toyota Axio	33850	4835.714286	604.4642857	31.81390977	31.81391	283.6740299	68.62642105	11847.5	1692.5	17959.1175	3249.6
Toyota Corolla X	277475	16322.05882	2720.343137	247.3039216	247.30392	2205.126642	533.4642353	30059.79167	4624.583333	49071.45375	8879.2
Toyota Corolla X	265985	14776.94444	2462.824074	102.6176698	732.00604	6527.053919	1579.024878	37237.9	5319.7	56447.3367	10213.824
Toyota Axio	47972	6853.142857	856.6428571	61.18877551	61.18877	545.599917	131.9915314	11193.46667	1599.066667	16967.6964	3070.208
Toyota Corolla X	219700	18308.33333	2615.476190	174.3650794	174.36508	1554.755297	376.1264	21970	2746.25	29140.45875	5272.8
Toyota Allion	347750	24839.28571	4139.880952	459.9867725	459.98677	4101.548737	992.2466667	22603.75	3477.5	36899.7525	6676.8
Toyota Allion	183504	12233.6	2038.933333	165.3189189	453.56729	4044.308354	978.3990734	32113.2	4587.6	48679.0236	8808.192
Toyota Allion	371900	21876.47059	4375.294118	195.9086918	474.53439	4231.264966	1023.627617	31877.14286	5312.857143	56374.72714	10200.68571
Toyota Axio	89875	12839.28571	1834.183673	141.0910518	141.09105	1258.061883	304.3503297	8987.5	1283.928571	13623.76607	2465.142857
Toyota Premio	198150	12384.375	2064.0625	108.6348684	527.65508	4704.924438	1138.215316	32199.375	4953.75	52564.24125	9511.2
Toyota Corolla X	176750	13596.15385	1942.307692	215.8119658	215.81197	1924.323369	465.5323077	28280	3535	37509.885	6787.2
Toyota Corolla X	296651	16480.61111	3296.122222	299.6474747	299.64747	2671.85666	646.3755607	37081.375	4944.183333	52462.72935	9492.832
Toyota Axio	131107	18729.57143	2081.063492	109.5296575	109.52966	976.6394495	236.2686147	10488.56	1311.07	13911.76377	2517.2544
Toyota Axio	101875	11319.44444	1414.930556	48.79070881	48.79070	435.0504885	105.2474138	11885.41667	1697.916667	18016.59375	3260
Toyota Allion	72125	8013.888889	1001.736111	111.3040123	111.30401	992.4607805	240.0961111	13222.91667	2404.166667	25510.6125	4616
Toyota Premio	221375	20125	2875	73.71794872	73.71794	657.3183785	159.0184615	17986.71875	2767.1875	29362.62656	5313
Toyota Corolla X	154712	11050.85714	1578.693878	83.08915145	83.08915	740.8782699	179.2332704	27074.6	3867.8	41041.2258	7426.176
Toyota Premio	129106	16138.25	2017.28125	155.1754808	155.17548	1383.648042	334.7321331	16599.34286	1844.371429	19570.62523	3541.193143
Toyota Allion	31938	2903.454545	483.9090909	45.36647727	45.36647	404.5177572	97.86093545	5475.085714	912.5142857	9682.689086	1752.027429
Toyota Corolla X	153674	10976.71429	1829.452381	96.28696742	96.28696	858.558796	207.7025432	23051.1	3841.85	40765.87035	7376.352
Toyota Allion	70859	11809.83333	1476.229167	94.22739362	94.22739	840.1942629	203.2597953	10628.85	1417.18	15037.69698	2720.9856
Toyota Allion	45876	11469	1433.625	159.2916667	159.29167	1420.3507	343.61124	7340.16	917.52	9735.80472	1761.6384
Toyota Premio	31375	6275	784.375	56.02678571	56.02678	499.5721745	120.8565	7320.833333	1045.833333	11097.3375	2008
Toyota Premio	357850	25560.71429	3651.530612	192.1858217	192.18582	1713.656917	414.5678797	26838.75	3578.5	37971.4635	6870.72
Toyota Corolla X	243725	18748.07692	3124.679487	240.3599606	240.35996	2143.209656	518.4852781	27854.28571	3481.785714	36945.22821	6685.028571

Toyota Premio	56750	8107.142857	1158.163265	105.2875696	105.28757	938.8141655	227.1179221	8512.5	945.8333333	10036.2375	1816
Toyota Premio	160741	11481.5	1640.214286	86.32706767	86.32068	769.7496896	186.2178442	28129.675	4018.525	42640.56878	7715.568
Toyota Corolla X	300256	21446.85714	3063.836735	340.4263039	340.4263	3035.467887	734.3403886	24020.48	3002.56	31860.16416	5764.9152
Toyota Corolla X	48275	5363.888889	670.4861111	39.44035948	39.44035	351.67654	85.07758824	3218.333333	536.3888889	5691.6225	1029.866667
Toyota Premio	143610	15956.66667	1772.962963	161.1784512	161.17845	1437.174528	347.6812606	20344.75	2393.5	25397.4285	4595.52
Toyota Premio	64874	10812.33333	1351.541667	56.31423611	56.31436	502.1352739	121.476565	10379.84	1297.48	13767.56028	2491.1616
Toyota Premio	45928	7654.666667	956.8333333	39.86805556	39.86805	355.4901634	86.00018	5511.36	918.56	9746.84016	1763.6352
Toyota Corolla X	404261	22458.94444	3208.420635	125.0034014	125.0034	1114.613666	269.6473371	30319.575	5053.2625	53620.16839	9702.264
Toyota Premio	32976	4710.857143	672.9795918	35.41997852	35.41997	315.828143	76.40514406	9068.4	1648.8	17495.4168	3165.696
Toyota Corolla X	187150	17013.63636	2430.519481	83.81101657	83.81101	747.3149005	180.7904201	21834.16667	3119.166667	33097.4775	5988.8
Toyota Corolla X	229462	14341.375	2048.767857	85.36532738	85.36532	761.174172	184.143255	29830.06	4589.24	48696.42564	8811.3408
Toyota Allion	63975	7996.875	1332.8125	148.0902778	148.09028	1320.471648	319.4485	7037.25	1279.5	13576.7745	2456.64
Toyota Axio	167625	18625	2660.714286	204.6703297	204.67033	1824.977113	441.4984615	16762.5	2394.642857	25409.55536	4597.714286
Toyota Corolla X	167626	15238.72727	2176.961039	197.905549	197.90555	1764.657818	426.9060179	16762.6	2793.766667	29644.6581	5364.032
Toyota Corolla X	249103	13839.05556	2306.509259	96.10455247	96.10452	856.9322627	207.3090522	34874.42	4982.06	52864.63866	9565.5552
Toyota Premio	72621	7262.1	1037.442857	185.2576531	185.25765	1651.880746	399.6229886	16944.9	2420.7	25686.0477	4647.744
Toyota Premio	213600	21360	3051.428571	179.4957983	179.4958	1600.504208	387.1939765	16613.33333	2373.333333	25183.44	4556.8
Toyota Allion	189800	17254.54545	3450.909091	230.0606061	230.06061	2051.373745	496.2683345	14235	2372.5	25174.5975	4555.2
Toyota Axio	28800	7200	900	37.5	37.5	334.3750013	80.892	4320	576	6111.936	1105.92
Toyota Corolla X	155375	8631.944444	1233.134921	51.38062169	51.38062	458.1438785	110.8341667	18645	3107.5	32973.6825	5966.4
Toyota Premio	36605	5229.285714	747.0408163	39.31793777	39.31793	350.5849458	84.81350977	6405.875	915.125	9710.391375	1757.04
Toyota Allion	-31532	-2252.285714	-375.3809524	-25.02539683	-25.02539	-223.1431225	-53.982784	-2561.975	-394.15	-4182.32565	-756.768
Toyota Allion	56688	11337.6	1417.2	74.58947368	74.58947	665.0894762	160.8984455	4535.04	566.88	6015.16368	1088.4096
Toyota Corolla X	209425	16109.61538	2684.935897	244.0850816	244.08508	2176.425319	526.5208112	22687.70833	3490.416667	37036.81125	6701.6
Toyota Premio	73100	10442.85714	1491.836735	99.45578231	99.45578	886.8140623	214.5380571	5482.5	913.75	9695.80125	1754.4
Toyota Allion	248206	22564.18182	3223.454545	214.8969697	214.89697	1916.164654	463.5585513	21718.025	3102.575	32921.42333	5956.944
Toyota Corolla X	113316	10301.45455	1471.636364	77.45454545	77.45455	690.6363662	167.0787491	16997.4	2832.9	30059.9019	5439.168
Toyota Corolla X	157187	11227.64286	1871.27381	77.96974206	77.96974	695.2302027	168.19009	18862.44	3143.74	33358.22514	6035.9808
Toyota Axio	32937	3659.666667	522.8095238	31.68542569	31.68542	282.5283801	68.34926545	6116.871429	941.0571429	9985.557343	1806.829714
Toyota Axio	46001	11500.25	1437.53125	59.89713542	59.89713	534.0827928	129.2053088	7820.17	920.02	9762.33222	1766.4384
Toyota Corolla X	423175	26448.4375	4408.072917	232.0038377	232.00384	2068.700894	500.4601184	25390.5	4231.75	44903.09925	8124.96
Toyota Premio	494376	30898.5	4414.071429	490.452381	490.45238	4373.200413	1057.96464	37078.2	4943.76	52458.23736	9492.0192
Toyota Allion	66761	7417.888889	1059.698413	55.77360067	55.77360	497.3146078	120.3103495	13352.2	1669.025	17710.02428	3204.528
Toyota Axio	47176	6739.428571	962.7755102	40.11564626	40.11564	357.6978471	86.53426286	6604.64	943.52	10011.69072	1811.5584
Toyota Allion	150725	9420.3125	1345.758929	96.12563776	363.9042	3244.812463	784.9850281	40193.33333	5024.166667	53311.4325	9646.4
Toyota Corolla X	103750	6916.666667	1152.777778	157.1969697	157.19697	1401.672985	339.0927273	24900	4150	44035.65	7968
Toyota Allion	280400	20028.57143	3338.095238	164.8442093	164.84421	1469.860872	355.5887407	29689.41176	3298.823529	35003.81647	6333.741176

Toyota Corolla X	35000	3888.888889	555.5555556	24.15458937	24.154589	215.3784227	52.10434783	11666.66667	1458.333333	15474.375	2800
Toyota Noah	51100	5677.777778	811.1111111	42.69005848	42.690058	380.6530229	92.08757895	25550	2555	27111.105	4905.6
Toyota Corolla X	167000	11928.57143	1704.081633	568.0272109	568.02721	5064.909316	1225.302857	29225	4175	44300.925	8016
Toyota Axio	255000	28333.33333	3541.666667	885.4166667	885.41667	7894.965307	1909.95	14025	2550	27058.05	4896
Toyota Corolla X	147238	11326	1415.75	157.3055556	157.30556	1402.641209	339.32696	29447.6	2944.76	31246.84836	5653.9392
Suc-ceed	39000	2600	371.4285714	74.28571429	74.285714	662.3809549	160.2432	26000	3250	34485.75	6240
Toyota Corolla	60746	12149.2	1518.65	650.85	650.85	5803.412522	1403.961552	12149.2	1214.92	12891.51612	2332.6464
Toyota Axio	5000	500	83.33333333	83.33333333	83.333333	743.0555583	179.76	20000	2500	26527.5	4800
Mitsubishi Qx	10900	3633.333333	519.047619	79.85347985	79.85348	712.0268647	172.2535385	3270	363.3333333	3855.33	697.6
Toyota Allion	81000	6750	1125	68.18181818	68.181818	607.9545477	147.0763636	16200	2314.285714	24556.88571	4443.428571
Toyota Allion	30338	3792.25	948.0625	316.0208333	316.02083	2817.852441	681.69486	15169	1516.9	16095.8259	2912.448

Calculation of Fuel Consumption, Energy Consumption and GHG Emission Per Kilometer (Gasoline)

Car Model Name	Average Fuel Consumption (L/km)	Energy Consumption (kWh/km)	GHG Emission (kg/km)
Audi A3	0.1	0.8916667	0.215712
Audi A8	0.222222222	1.9814815	0.47936
BMW	0.125	1.1145833	0.26964
Honda 2014	0.1	0.8916667	0.215712
Honda Civic	0.142857143	1.2738095	0.30816
Honda CRV	0.25	2.2291667	0.53928
Honda Insight (Hybrid)	0.090909091	0.8106061	0.1961018
Honda Vezel	0.083333333	0.7430556	0.17976
Honda Vezel	0.083333333	0.7430556	0.17976
Honda Vezel	0.090909091	0.8106061	0.1961018
Honda Vezel	0.125	1.1145833	0.26964
Hundai	0.166666667	1.4861111	0.35952
Hyundai Kia	0.222222222	1.9814815	0.47936
Hyundai Xcent	0.111111111	0.9907407	0.23968
Marcedes S320	0.166666667	1.4861111	0.35952
Mazda Axela	0.111111111	0.9907407	0.23968
Mercedes E Class	0.25	2.2291667	0.53928
Mitsubishi Lancer	0.125	1.1145833	0.26964
Mitsubishi Asx 19	0.2	1.7833333	0.431424
Mitsubishi Outlander	0.285714286	2.5476191	0.61632
Mitsubishi Outlander	0.111111111	0.9907407	0.23968
Mitsubishi Outlander	0.2	1.7833333	0.431424
Mitsubishi Outlander	0.166666667	1.4861111	0.35952
Mitsubishi Outlander	0.1	0.8916667	0.215712
Nissan Bluebird	0.125	1.1145833	0.26964
Nissan Selero	0.285714286	2.5476191	0.61632
Nissan Xtrail	0.25	2.2291667	0.53928
Nissan Xtrail	0.2	1.7833333	0.431424
Nissan Xtrail	0.2	1.7833333	0.431424
Ssangyong Actyon	0.285714286	2.5476191	0.61632
Ssangyong Korando	0.166666667	1.4861111	0.35952
Toyota Allion	0.125	1.1145833	0.26964
Toyota Allion	0.1	0.8916667	0.215712
Toyota Allion	0.125	1.1145833	0.26964
Toyota Allion	0.1	0.8916667	0.215712
Toyota Allion	0.125	1.1145833	0.26964
Toyota Allion	0.125	1.1145833	0.26964
Toyota Allion	0.125	1.1145833	0.26964
Toyota Allion	0.125	1.1145833	0.26964
Toyota Allion	0.090909091	0.8106061	0.1961018
Toyota Allion	0.1	0.8916667	0.215712
Toyota Allion	0.142857143	1.2738095	0.30816
Toyota Allion	0.166666667	1.4861111	0.35952
Toyota Allion	0.166666667	1.4861111	0.35952
Toyota Allion	0.111111111	0.9907407	0.23968
Toyota Allion	0.133333333	1.1888889	0.287616
Toyota Allion	0.25	2.2291667	0.53928
Toyota Allion	0.1	0.8916667	0.215712
Toyota Allion	0.111111111	0.9907407	0.23968
Toyota Allion	0.2	1.7833333	0.431424
Toyota Allion	0.125	1.1145833	0.26964
Toyota Allion	0.142857143	1.2738095	0.30816
Toyota Allion	0.083333333	0.7430556	0.17976
Toyota Allion	0.125	1.1145833	0.26964

Toyota Allion	0.142857143	1.2738095	0.30816
Toyota Allion	0.125	1.1145833	0.26964
Toyota Allion	0.1	0.8916667	0.215712
Toyota Aqua	0.1	0.8916667	0.215712
Toyota Avanza	0.1	0.8916667	0.215712
Toyota Axio	0.125	1.1145833	0.26964
Toyota Axio	0.285714286	2.5476191	0.61632
Toyota Axio	0.1	0.8916667	0.215712
Toyota Axio	0.111111111	0.9907407	0.23968
Toyota Axio	0.1	0.8916667	0.215712
Toyota Axio	0.125	1.1145833	0.26964
Toyota Axio	0.142857143	1.2738095	0.30816
Toyota Axio	0.111111111	0.9907407	0.23968
Toyota Axio	0.1	0.8916667	0.215712
Toyota Axio	0.111111111	0.9907407	0.23968
Toyota Axio	0.125	1.1145833	0.26964
Toyota Axio	0.142857143	1.2738095	0.30816
Toyota Axio	0.125	1.1145833	0.26964
Toyota Axio	0.125	1.1145833	0.26964
Toyota Axio	0.090909091	0.8106061	0.1961018
Toyota Axio	0.166666667	1.4861111	0.35952
Toyota Axio	0.142857143	1.2738095	0.30816
Toyota Axio	0.142857143	1.2738095	0.30816
Toyota Axio	0.166666667	1.4861111	0.35952
Toyota Axio	0.142857143	1.2738095	0.30816
Toyota Axio	0.125	1.1145833	0.26964
Toyota Axio	0.125	1.1145833	0.26964
Toyota Axio	0.1	0.8916667	0.215712
Toyota Camry	0.166666667	1.4861111	0.35952
Toyota Carina	0.125	1.1145833	0.26964
Toyota Celica	0.125	1.1145833	0.26964
Toyota Chaser	0.222222222	1.9814815	0.47936
Toyota Corolla	0.125	1.1145833	0.26964
Toyota Corolla X	0.111111111	0.9907407	0.23968
Toyota Corolla X	0.166666667	1.4861111	0.35952
Toyota Corolla X	0.076923077	0.6858974	0.1659323
Toyota Corolla X	0.125	1.1145833	0.26964
Toyota Corolla X	0.111111111	0.9907407	0.23968
Toyota Corolla X	0.125	1.1145833	0.26964
Toyota Corolla X	0.166666667	1.4861111	0.35952
Toyota Corolla X	0.125	1.1145833	0.26964
Toyota Corolla X	0.125	1.1145833	0.26964
Toyota Estima	0.2	1.7833333	0.431424
Toyota Fielder	0.083333333	0.7430556	0.17976
Toyota Fielder	0.1	0.8916667	0.215712
Toyota Fielder	0.142857143	1.2738095	0.30816
Toyota Fielder	0.125	1.1145833	0.26964
Toyota Fielder	0.142857143	1.2738095	0.30816
Toyota Harrier	0.181818182	1.6212121	0.3922036
Toyota IST	0.1	0.8916667	0.215712
Toyota Noah	0.222222222	1.9814815	0.47936
Toyota Noah	0.2	1.7833333	0.431424
Toyota Noah	0.142857143	1.2738095	0.30816
Toyota Noah Hybrid	0.1	0.8916667	0.215712
Toyota Prado	0.2	1.7833333	0.431424
Toyota Premio	0.1	0.8916667	0.215712
Toyota Premio	0.133333333	1.1888889	0.287616
Toyota Premio	0.133333333	1.1888889	0.287616
Toyota Premio	0.111111111	0.9907407	0.23968
Toyota Premio	0.1	0.8916667	0.215712

Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.166666667	1.4861111	0.35952
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.090909091	0.8106061	0.1961018
Toyota Premio	0.090909091	0.8106061	0.1961018
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.1	0.8916667	0.215712
Toyota Premio	0.142857143	1.2738095	0.30816
Toyota Premio	0.166666667	1.4861111	0.35952
Toyota Premio	0.090909091	0.8106061	0.1961018
Toyota Premio	0.142857143	1.2738095	0.30816
Toyota Premio	0.166666667	1.4861111	0.35952
Toyota Premio	0.142857143	1.2738095	0.30816
Toyota Premio	0.166666667	1.4861111	0.35952
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.166666667	1.4861111	0.35952
Toyota Premio	0.1	0.8916667	0.215712
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.142857143	1.2738095	0.30816
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.090909091	0.8106061	0.1961018
Toyota Premio	0.166666667	1.4861111	0.35952
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.111111111	0.9907407	0.23968
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.111111111	0.9907407	0.23968
Toyota Premio	0.111111111	0.9907407	0.23968
Toyota Premio	0.125	1.1145833	0.26964
Toyota Premio	0.111111111	0.9907407	0.23968
Toyota Premio	0.142857143	1.2738095	0.30816
Toyota Probox	0.111111111	0.9907407	0.23968
Toyota Ractis 2012	0.1	0.8916667	0.215712
Toyota Rush	0.142857143	1.2738095	0.30816
Toyota Starline	0.125	1.1145833	0.26964
Toyota Vitz	0.111111111	0.9907407	0.23968
Toyota Vitz	0.125	1.1145833	0.26964
Toyota Vitz	0.125	1.1145833	0.26964
Toyota Vitz	0.142857143	1.2738095	0.30816
Toyota Vitz	0.166666667	1.4861111	0.35952
Toyota Yaris	0.125	1.1145833	0.26964

Calculation of Fuel Consumption, Energy Consumption and GHG Emission Per Kilometer (Bi-Fuel)

	For Oil			For CNG		
Car Model Name	**Average Fuel Consumption (m3/km)**	**Energy Consumption (kWh/km)**	**GHG Emission (kg/km)**	**Average Fuel Consumption (m3/km)**	**Energy Consumption (kWh/km)**	**GHG Emission (kg/km)**
Mitsubishi Pajero	0.098095238	0.874682543	0.2116032	0.714285714	7.579285714	1.371428571
Mitsubishi Qx	0.019047619	0.16984127	0.041088	0.1	1.0611	0.192
Succeed	0.023809524	0.212301588	0.05136	1.25	13.26375	2.4
Toyota Corolla Sprinter	0.084210526	0.750877196	0.181652211	1.05	11.14155	2.016
Toyota 100	0.05979798	0.533198655	0.128991418	0.866666667	9.1962	1.664
Toyota 100	0.033928571	0.302529763	0.073188	0.328571429	3.486471429	0.630857143
Toyota 111	0.102898551	0.917512081	0.221964522	5.4	57.2994	10.368
Toyota 90	0.091428571	0.815238098	0.1972224	0.58	6.15438	1.1136
Toyota AE111	0.051960784	0.463316995	0.112085647	0.55	5.83605	1.056
Toyota Allion	0.01625	0.144895834	0.0350532	0.433333333	4.5981	0.832
Toyota Allion	0.023809524	0.212301588	0.05136	1.083333333	11.49525	2.08
Toyota Allion	0.023076923	0.205769232	0.049779692	0.55	5.83605	1.056
Toyota Allion	0.026666667	0.237777779	0.0575232	0.5	5.3055	0.96
Toyota Allion	0.004504505	0.040165165	0.009716757	0.378378378	4.014972973	0.726486486
Toyota Allion	0.04	0.356666668	0.0862848	1.1	11.6721	2.112
Toyota Allion	0.010416667	0.092881945	0.02247	1	10.611	1.92
Toyota Allion	0.0025	0.022291667	0.0053928	0.09	0.95499	0.1728
Toyota Allion	0.002	0.017833333	0.00431424	0.04	0.42444	0.0768
Toyota Allion	0.028571429	0.254761906	0.061632	0.085714286	0.909514286	0.164571429
Toyota Allion	0.012820513	0.11431624	0.027655385	1.076923077	11.42723077	2.067692308
Toyota Allion	0.044791667	0.399392363	0.096621	0.32	3.39552	0.6144
Toyota Allion	0.008888889	0.07925926	0.0191744	0.24	2.54664	0.4608
Toyota Allion	0.009230769	0.082307693	0.019911877	0.16	1.69776	0.3072
Toyota Allion	0.045454545	0.405303032	0.098050909	2	21.222	3.84
Toyota Allion	0.02	0.178333334	0.0431424	0.3	3.1833	0.576
Toyota Allion	0.008571429	0.076428572	0.0184896	0.32	3.39552	0.6144
Toyota Allion	0.005	0.044583334	0.0107856	0.3	3.1833	0.576
Toyota Allion	0.008333333	0.074305556	0.017976	0.35	3.71385	0.672
Toyota Allion	0.003703704	0.033024691	0.007989333	0.077777778	0.8253	0.149333333
Toyota Allion	0.004761905	0.042460318	0.010272	0.166666667	1.7685	0.32
Toyota Allion	0.008333333	0.074305556	0.017976	0.4	4.2444	0.768
Toyota Allion	0.011904762	0.106150794	0.02568	0.133333333	1.4148	0.256
Toyota Allion	0.008928571	0.079613096	0.01926	0.1125	1.1937375	0.216
Toyota Allion	0.011904762	0.106150794	0.02568	0.041666667	0.442125	0.08
Toyota Allion	0.006666667	0.059444445	0.0143808	0.28	2.97108	0.5376
Toyota Allion	0.005	0.044583334	0.0107856	0.18	1.90998	0.3456
Toyota Allion	0.016666667	0.148611112	0.035952	0.14	1.48554	0.2688
Toyota Allion	0.036217949	0.322943377	0.078126462	0.375	3.979125	0.72
Toyota Allion	0.021333333	0.190222223	0.04601856	0.242857143	2.576957143	0.466285714
Toyota Allion	0.0125	0.111458334	0.026964	0.3	3.1833	0.576
Toyota Allion	0.014285714	0.127380953	0.030816	0.314285714	3.334885714	0.603428571
Toyota Allion	0.0075	0.066875	0.0161784	0.12	1.27332	0.2304
Toyota Allion	0.0125	0.111458334	0.026964	0.08	0.84888	0.1536
Toyota Allion	0.016666667	0.148611112	0.035952	0.16	1.69776	0.3072
Toyota Allion	0.0125	0.111458334	0.026964	0.1375	1.4590125	0.264
Toyota Allion	0.010416667	0.092881945	0.02247	0.175	1.856925	0.336
Toyota Allion	0.00625	0.055729167	0.013482	0.05	0.53055	0.096
Toyota Allion	0.008928571	0.079613096	0.01926	0.1375	1.4590125	0.264
Toyota Allion	0.007142857	0.063690476	0.015408	0.225	2.387475	0.432
Toyota Allion	0.038095238	0.339682541	0.082176	0.533333333	5.6592	1.024
Toyota Allion	0.007843137	0.069934641	0.016918588	0.164705882	1.747694118	0.316235294
Toyota Allion	0.00952381	0.084920635	0.020544	0.342857143	3.638057143	0.658285714
Toyota Allion	0.0625	0.557291669	0.13482	0.4	4.2444	0.768
Toyota Avanza	0.005714286	0.050952381	0.0123264	0.12	1.27332	0.2304
Toyota Axio	0.00625	0.055729167	0.013482	0.0875	0.9284625	0.168
Toyota Axio	0.03	0.267500001	0.0647136	0.52	5.51772	0.9984
Toyota Axio	0.022222222	0.198148149	0.047936	0.4	4.2444	0.768
Toyota Axio	0.005	0.044583334	0.0107856	0.05	0.53055	0.096
Toyota Axio	0.044332211	0.39529555	0.095629899	0.122222222	1.2969	0.234666667
Toyota Axio	0.02	0.178333334	0.0431424	0.4	4.2444	0.768
Toyota Axio	0.0125	0.111458334	0.026964	0.15	1.59165	0.288
Toyota Axio	0.02962963	0.264197532	0.063914667	0.2	2.1222	0.384
Toyota Axio	0.016666667	0.148611112	0.035952	0.14	1.48554	0.2688
Toyota Axio	0.005357143	0.047767857	0.011556	0.175	1.856925	0.336
Toyota Axio	0.025	0.222916668	0.053928	1.125	11.937375	2.16
Toyota Axio	0.008333333	0.074305556	0.017976	0.06	0.63666	0.1152
Toyota Axio	0.01	0.089166667	0.0215712	0.18	1.90998	0.3456

Toyota Axio	0.006666667	0.059444445	0.0143808	0.14	1.48554	0.2688
Toyota Axio	0.002777778	0.024768519	0.005992	0.075	0.795825	0.144
Toyota Axio	0.013888889	0.123842593	0.02996	0.2	2.1222	0.384
Toyota Axio	0.006666667	0.059444445	0.0143808	0.24	2.54664	0.4608
Toyota Axio	0.006666667	0.059444445	0.0143808	0.18	1.90998	0.3456
Toyota Axio	0.011904762	0.106150794	0.02568	0.2	2.1222	0.384
Toyota Axio	0.00952381	0.084920635	0.020544	0.233333333	2.4759	0.448
Toyota Axio	0.010416667	0.092881945	0.02247	0.116666667	1.23795	0.224
Toyota Axio	0.008928571	0.079613096	0.01926	0.1125	1.1937375	0.216
Toyota Axio	0.00625	0.055729167	0.013482	0.35	3.71385	0.672
Toyota Axio	0.008333333	0.074305556	0.017976	0.233333333	2.4759	0.448
Toyota Axio	0.010204082	0.090986395	0.022011429	0.1	1.0611	0.192
Toyota Axio	0.005555556	0.049537037	0.011984	0.07	0.74277	0.1344
Toyota Axio	0.004166667	0.037152778	0.008988	0.15	1.59165	0.288
Toyota Axio	0.010204082	0.090986395	0.022011429	0.128571429	1.364271429	0.246857143
Toyota Axio	0.005	0.044583334	0.0107856	0.08	0.84888	0.1536
Toyota Axio	0.008163265	0.072789116	0.017609143	0.257142857	2.728542857	0.493714286
Toyota Axio	0.005	0.044583334	0.0107856	0.08	0.84888	0.1536
Toyota Axio	0.005714286	0.050952381	0.0123264	0.14	1.48554	0.2688
Toyota Axio	0.025	0.222916668	0.053928	0.09	0.95499	0.1728
Toyota Axio	0.083333333	0.743055558	0.17976	5	53.055	9.6
Toyota Cabina	0.035102041	0.312993198	0.075719314	0.56	5.94216	1.0752
Toyota Carina	0.080291005	0.715928133	0.173197333	0.622222222	6.6024	1.194666667
Toyota Corolla	0.10591133	0.94437603	0.228463448	5.5	58.3605	10.56
Toyota Corolla	0.022222222	0.198148149	0.047936	1.333333333	14.148	2.56
Toyota Corolla	0.057291667	0.510850696	0.123585	1.083333333	11.49525	2.08
Toyota Corolla	0.00375	0.0334375	0.0080892	0.17	1.80387	0.3264
Toyota Corolla	0.031851852	0.284012347	0.068708267	1.066666667	11.3184	2.048
Toyota Corolla	0.038988095	0.347643851	0.084102	0.75	7.95825	1.44
Toyota Corolla	0.030952381	0.275992065	0.066768	0.8	8.4888	1.536
Toyota Corolla	0.020833333	0.18576389	0.04494	0.1	1.0611	0.192
Toyota Corolla	0.052222222	0.46564815	0.1126496	0.5	5.3055	0.96
Toyota Corolla	0.004166667	0.037152778	0.008988	0.1875	1.9895625	0.36
Toyota Corolla	0.0375	0.334375001	0.080892	0.1	1.0611	0.192
Toyota Corolla 110	0.063458647	0.565839601	0.136887916	0.92	9.76212	1.7664
Toyota Corolla Gli	0.048809524	0.435218256	0.105288	0.32	3.39552	0.6144
Toyota Corolla X	0.02	0.178333334	0.0431424	0.35	3.71385	0.672
Toyota Corolla X	0.015384615	0.137179488	0.033186462	0.25	2.65275	0.48
Toyota Corolla X	0.025925926	0.23117284	0.055925333	0.325	3.448575	0.624
Toyota Corolla X	0.004444444	0.03962963	0.0095872	0.311111111	3.3012	0.597333333
Toyota Corolla X	0.00952381	0.084920635	0.020544	0.533333333	5.6592	1.024
Toyota Corolla X	0.016666667	0.148611112	0.035952	0.65	6.89715	1.248
Toyota Corolla X	0.033777778	0.301185186	0.07286272	0.26	2.75886	0.4992
Toyota Corolla X	0.033333333	0.297222223	0.071904	0.64	6.79104	1.2288
Toyota Corolla X	0.01	0.089166667	0.0215712	0.75	7.95825	1.44
Toyota Corolla X	0.017	0.151583334	0.03667104	0.26	2.75886	0.4992
Toyota Corolla X	-0.035714286	-0.318452382	-0.07704	1.166666667	12.3795	2.24
Toyota Corolla X	0.004166667	0.037152778	0.008988	0.466666667	4.9518	0.896
Toyota Corolla X	0.053571429	0.477678573	0.11556	0.633333333	6.7203	1.216
Toyota Corolla X	0.030769231	0.274358975	0.066372923	0.5	5.3055	0.96
Toyota Corolla X	0.010416667	0.092881945	0.02247	0.25	2.65275	0.48
Toyota Corolla X	0.031043956	0.276808609	0.066965538	0.35	3.71385	0.672
Toyota Corolla X	0.013888889	0.123842593	0.02996	0.233333333	2.4759	0.448
Toyota Corolla X	0.02	0.178333334	0.0431424	1.3	13.7943	2.496
Toyota Corolla X	0.0625	0.557291669	0.13482	1	10.611	1.92
Toyota Corolla X	0.005714286	0.050952381	0.0123264	0.28	2.97108	0.5376
Toyota Corolla X	0.007936508	0.070767196	0.01712	0.277777778	2.9475	0.533333333
Toyota Corolla X	0.016666667	0.148611112	0.035952	0.416666667	4.42125	0.8
Toyota Corolla X	0.010204082	0.090986395	0.022011429	0.357142857	3.789642857	0.685714286
Toyota Corolla X	0.02	0.178333334	0.0431424	0.25	2.65275	0.48
Toyota Corolla X	0.003125	0.027864583	0.006741	0.3125	3.3159375	0.6
Toyota Corolla X	0.023809524	0.212301588	0.05136	0.357142857	3.789642857	0.685714286
Toyota Corolla X	0.013333333	0.118888889	0.0287616	0.833333333	8.8425	1.6
Toyota Corolla X	0.01	0.089166667	0.0215712	0.25	2.65275	0.48
Toyota Corolla X	0.04	0.356666668	0.0862848	0.933333333	9.9036	1.792
Toyota Corolla X	0.005555556	0.049537037	0.011984	0.25	2.65275	0.48
Toyota Corolla X	0.00625	0.055729167	0.013482	0.2	2.1222	0.384
Toyota Corolla X	0.006079027	0.054204661	0.013113191	0.29787234	3.160723404	0.571914894
Toyota Corolla X	0.003861004	0.034427285	0.008328649	0.378378378	4.014972973	0.726486486
Toyota Corolla X	0.006666667	0.059444445	0.0143808	0.22	2.33442	0.4224
Toyota Corolla X	0.02	0.178333334	0.0431424	0.28	2.97108	0.5376
Toyota Corolla X	0.0125	0.111458334	0.026964	0.3	3.1833	0.576
Toyota Corolla X	0.005714286	0.050952381	0.0123264	0.34	3.60774	0.6528
Toyota Corolla X	0.037301587	0.332605821	0.080464	0.18	1.90998	0.3456
Toyota Corolla X	0.00952381	0.084920635	0.020544	0.466666667	4.9518	0.896
Toyota Corolla X	0.008333333	0.074305556	0.017976	0.35	3.71385	0.672
Toyota Corolla X	0.01	0.089166667	0.0215712	0.13	1.37943	0.2496
Toyota Corolla X	0.0125	0.111458334	0.026964	0.1625	1.7242875	0.312
Toyota Corolla X	0.005714286	0.050952381	0.0123264	0.3	3.1833	0.576
Toyota Corolla X	0.004166667	0.037152778	0.008988	0.233333333	2.4759	0.448
Toyota Corolla X	0.007142857	0.063690476	0.015408	0.35	3.71385	0.672

Toyota Corolla X	0.008928571	0.079613096	0.01926	0.1375	1.4590125	0.264
Toyota Corolla X	0.036666667	0.326944446	0.0790944	0.833333333	8.8425	1.6
Toyota Corolla X	0.009259259	0.082561729	0.019973333	0.122222222	1.2969	0.234666667
Toyota Corolla X	0.008	0.071333334	0.01725696	0.213333333	2.26368	0.4096
Toyota Corolla X	0.006666667	0.059444445	0.0143808	0.32	3.39552	0.6144
Toyota Corolla X	0.014285714	0.127380953	0.030816	0.24	2.54664	0.4608
Toyota Corolla X	0.013888889	0.123842593	0.02996	0.283333333	3.00645	0.544
Toyota Corolla X	0.049333333	0.439888891	0.10641792	0.36	3.81996	0.6912
Toyota Corolla X	0.008928571	0.079613096	0.01926	0.15	1.59165	0.288
Toyota Corolla X	0.014285714	0.127380953	0.030816	0.26	2.75886	0.4992
Toyota Corolla X	0.016666667	0.148611112	0.035952	0.3	3.1833	0.576
Toyota Corolla X	0.007142857	0.063690476	0.015408	0.35	3.71385	0.672
Toyota Corolla X	0.008333333	0.074305556	0.017976	0.35	3.71385	0.672
Toyota Corolla X	0.011904762	0.106150794	0.02568	0.185714286	1.970614286	0.356571429
Toyota Corolla X	0.014285714	0.127380953	0.030816	0.14	1.48554	0.2688
Toyota Corolla X	0.006944444	0.061921297	0.01498	0.1	1.0611	0.192
Toyota Corolla X	0.005357143	0.047767857	0.011556	0.225	2.387475	0.432
Toyota Corolla X	0.004761905	0.042460318	0.010272	0.183333333	1.94535	0.352
Toyota Corolla X	0.005714286	0.050952381	0.0123264	0.32	3.39552	0.6144
Toyota Corolla X	0.011904762	0.106150794	0.02568	0.183333333	1.94535	0.352
Toyota Corolla X	0.006666667	0.059444445	0.0143808	0.36	3.81996	0.6912
Toyota Corolla X	0.005714286	0.050952381	0.0123264	0.36	3.81996	0.6912
Toyota Corolla X	0.013888889	0.123842593	0.02996	0.216666667	2.29905	0.416
Toyota Corolla X	0.007142857	0.063690476	0.015408	0.275	2.918025	0.528
Toyota Corolla X	0.006666667	0.059444445	0.0143808	0.28	2.97108	0.5376
Toyota Corolla X	0.008333333	0.074305556	0.017976	0.16	1.69776	0.3072
Toyota Corolla X	0.02	0.178333334	0.0431424	0.6	6.3666	1.152
Toyota Corolla X	0.005952381	0.053075397	0.01284	0.375	3.979125	0.72
Toyota Corolla X	0.035714286	0.318452382	0.07704	0.35	3.71385	0.672
Toyota Corolla X	0.0125	0.111458334	0.026964	0.26	2.75886	0.4992
Toyota Corona	0.071666667	0.63902778	0.1545936	0.575	6.101325	1.104
Toyota Corona	0.0125	0.111458334	0.026964	1.35	14.32485	2.592
Toyota Corona	0.09367284	0.835249489	0.202063556	0.3	3.1833	0.576
Toyota Corona	0.088666667	0.790611114	0.19126464	2.8	29.7108	5.376
Toyota Corsa	0.066666667	0.594444447	0.143808	1.45	15.38595	2.784
Toyota Fielder	0.033854167	0.301866321	0.0730275	1	10.611	1.92
Toyota Fielder	0.005	0.044583334	0.0107856	0.7	7.4277	1.344
Toyota Fielder	0.005714286	0.050952381	0.0123264	0.16	1.69776	0.3072
Toyota Fielder	0.00625	0.055729167	0.013482	0.225	2.387475	0.432
Toyota Fielder	0.025	0.222916668	0.053928	0.8	8.4888	1.536
Toyota Fielder	0.005	0.044583334	0.0107856	0.035	0.371385	0.0672
Toyota Fielder	0.008333333	0.074305556	0.017976	0.106666667	1.13184	0.2048
Toyota Fielder	0.005555556	0.049537037	0.011984	0.133333333	1.4148	0.256
Toyota Fielder	0.00952381	0.084920635	0.020544	0.128571429	1.364271429	0.246857143
Toyota Fielder	0.030952381	0.275992065	0.066768	0.85	9.01935	1.632
Toyota Fielder	0.038961039	0.347402599	0.084043636	0.063636364	0.675245455	0.122181818
Toyota Fielder	0.02	0.178333334	0.0431424	0.14	1.48554	0.2688
Toyota Fielder	0.011904762	0.106150794	0.02568	0.116666667	1.23795	0.224
Toyota Fielder	0.00952381	0.084920635	0.020544	0.066666667	0.7074	0.128
Toyota Fielder	0.00625	0.055729167	0.013482	0.1	1.0611	0.192
Toyota Harrier	0.061050061	0.544363046	0.131692308	0.2	2.1222	0.384
Toyota Noah	0.033333333	0.297222223	0.071904	1.6	16.9776	3.072
Toyota Noah	0.0125	0.111458334	0.026964	0.07	0.74277	0.1344
Toyota Noah	0.021538462	0.192051283	0.046461046	0.3	3.1833	0.576
Toyota Noah	0.020833333	0.18576389	0.04494	0.266666667	2.8296	0.512
Toyota Noah	0.007142857	0.063690476	0.015408	0.14	1.48554	0.2688
Toyota Noah	0.008333333	0.074305556	0.017976	0.225	2.387475	0.432
Toyota Noah	0.007142857	0.063690476	0.015408	0.214285714	2.273785714	0.411428571
Toyota Noah	0.008333333	0.074305556	0.017976	0.233333333	2.4759	0.448
Toyota Noah	0.03627451	0.323447714	0.078248471	0.19	2.01609	0.3648
Toyota Noah	0.007142857	0.063690476	0.015408	0.45	4.77495	0.864
Toyota Prado	0.025	0.222916668	0.053928	0.3	3.1833	0.576
Toyota Prado	0.083609023	0.745513787	0.180354695	0.44	4.66884	0.8448
Toyota Premio	0.020408163	0.18197279	0.044022857	0.185714286	1.970614286	0.356571429
Toyota Premio	0.033333333	0.297222223	0.071904	0.266666667	2.8296	0.512
Toyota Premio	0.067460317	0.601521166	0.14552	2.285714286	24.25371429	4.388571429
Toyota Premio	0.011111111	0.099074074	0.023968	0.45	4.77495	0.864
Toyota Premio	0.035714286	0.318452382	0.07704	0.4	4.2444	0.768
Toyota Premio	0.066666667	0.594444447	0.143808	0.6	6.3666	1.152
Toyota Premio	0.027777778	0.247685186	0.05992	0.5	5.3055	0.96
Toyota Premio	0.0875	0.780208336	0.188748	0.35	3.71385	0.672
Toyota Premio	0.007142857	0.063690476	0.015408	0.225	2.387475	0.432
Toyota Premio	0.037037037	0.330246915	0.079893333	0.288888889	3.0654	0.554666667
Toyota Premio	0.005102041	0.045493197	0.011005714	0.142857143	1.515857143	0.274285714
Toyota Premio	0.02	0.178333334	0.0431424	0.18	1.90998	0.3456
Toyota Premio	0.028571429	0.254761906	0.061632	0.9	9.5499	1.728
Toyota Premio	0.00625	0.055729167	0.013482	0.375	3.979125	0.72
Toyota Premio	0.011111111	0.099074074	0.023968	0.24	2.54664	0.4608
Toyota Premio	0.04875	0.434687502	0.1051596	0.2	2.1222	0.384
Toyota Premio	0.003205128	0.02857906	0.006913846	0.205128205	2.176615385	0.393846154
Toyota Premio	0.008571429	0.076428572	0.0184896	0.114285714	1.212685714	0.219428571

Toyota Premio	0.006060606	0.054040404	0.013073455	0.272727273	2.893909091	0.523636364
Toyota Premio	0.011111111	0.099074074	0.023968	0.233333333	2.4759	0.448
Toyota Premio	0.008928571	0.079613096	0.01926	0.1875	1.9895625	0.36
Toyota Premio	0.004081633	0.036394558	0.008804571	0.128571429	1.364271429	0.246857143
Toyota Premio	0.007142857	0.063690476	0.015408	0.55	5.83605	1.056
Toyota Premio	0.042261905	0.376835319	0.091164	0.4	4.2444	0.768
Toyota Premio	0.003571429	0.031845238	0.007704	0.1375	1.4590125	0.264
Toyota Premio	0.008928571	0.079613096	0.01926	0.114285714	1.212685714	0.219428571
Toyota Premio	0.008333333	0.074305556	0.017976	0.166666667	1.7685	0.32
Toyota Premio	0.007142857	0.063690476	0.015408	0.14	1.48554	0.2688
Toyota Premio	0.011904762	0.106150794	0.02568	0.116666667	1.23795	0.224
Toyota Premio	0.007142857	0.063690476	0.015408	0.35	3.71385	0.672
Toyota Premio	0.009259259	0.082561729	0.019973333	0.15	1.59165	0.288
Toyota Premio	0.005	0.044583334	0.0107856	0.12	1.27332	0.2304
Toyota Premio	0.005	0.044583334	0.0107856	0.12	1.27332	0.2304
Toyota Premio	0.007142857	0.063690476	0.015408	0.35	3.71385	0.672
Toyota Premio	0.023809524	0.212301588	0.05136	0.333333333	3.537	0.64
Toyota Premio	0.007936508	0.070767196	0.01712	0.111111111	1.179	0.213333333
Toyota Premio	0.007142857	0.063690476	0.015408	0.175	1.856925	0.336
Toyota Premio	0.008928571	0.079613096	0.01926	0.0875	0.9284625	0.168
Toyota Premio	0.014285714	0.127380953	0.030816	0.16	1.69776	0.3072
Toyota Probox	0.028061224	0.250212586	0.060531429	0.375	3.979125	0.72
Toyota Probox	0.016666667	0.148611112	0.035952	0.32	3.39552	0.6144
Toyota Probox	0.002222222	0.019814815	0.0047936	0.083333333	0.88425	0.16
Toyota Raum	0.028829994	0.257067443	0.062189756	0.307692308	3.264923077	0.590769231
Toyota Tercel	0.03745098	0.33393791	0.080786259	0.733333333	7.7814	1.408
Toyota Tercel	0.035828877	0.319474154	0.077287187	1	10.611	1.92
Toyota Vios	0.007352941	0.065563726	0.015861176	1	10.611	1.92
Toyota Warrior	0.020879121	0.186172162	0.045038769	0.325	3.448575	0.624