Fuel Economy for the ASEAN
Establishing Baselines for Fuel Economy of Light Duty Passenger Vehicles in the Philippines

CLEAN AIR ASIA

September 2015

Clean Air Asia Center, 2015. "Establishing Baselines for Fuel Economy of Light Duty Passenger Vehicles in the Philippines". Pasig City, Philippines.

Acknowledgements
This report is made possible by the United Nations Environment Programme, the Global Fuel Economy Initiative and FIA Foundation. Clean Air Asia acknowledges the partners in the regional work on harmonizing fuel economy policy in the ASEAN through the Partnership for Clean Fuels and Vehicles. Clean Air Asia would also like to acknowledge the support given by the Department of Energy in the Philippines for leading the discussions on fuel economy policy in the country during the many stakeholder meetings.

Cover photo by carguide.ph

Contact

Clean Air Asia Center
Unit 3505 Robinsons Equitable Tower
ADB Avenue, Pasig City, 1605 Philippines

Tel +632 6311042
Fax +63 2 6311390
center@cleanairasia.org

Clean Air Asia China Office
901A, Reignwood Building, No.8
YongAnDongLi, Jianguomenwai Avenue
Beijing 100022 China
Tel/Fax: +86 10 8528 8381
china@cleanairasia.org

Clean Air Asia India Office
1st Floor, Building No.4
Thyagraj Nagar Market
Lodhi Colony, 110003, India
Tel +91 11 60120260
Fax +91 11 43850032
india@cleanairasia.org

Country Networks in China, India, Indonesia, Nepal, Pakistan, Philippines, Sri Lanka, Vietnam

About Clean Air Asia
www.cleanairasia.org

Clean Air Initiative for Asian Cities (Clean Air Asia) promotes better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse emissions from transport, energy, and other sectors.

Clean Air Asia was established as the leading air quality management network for Asia by the Asian Development Bank, World Bank and USAID in 2001, and operates since 2007 as an independent non-profit organization. Clean Air Asia has offices in Manila, Beijing and Delhi, networks in eight Asian countries (China, India, Indonesia, Nepal, Pakistan, Philippines, Sri Lanka, and Vietnam) and is a UN recognized partnership of almost 250 organizations in Asia and worldwide.

Clean Air Asia uses knowledge and partnerships to enable Asia's 1,000+ cities and national governments understand the problems and identify effective policies and measures. Our four programs are: Air Quality and Climate Change, Low Emissions Urban Development, Clean Fuels and Vehicles, and Green Freight and Logistics.

The biennial Better Air Quality (BAQ) conference is the flagship event of Clean Air Asia bringing experts, policy and decision makers together to network, learn and share experiences on air quality management. Past BAQs have proven to influence policies, initiate new projects and establish partnerships.

EXECUTIVE SUMMARY

Fuel dependency is a global threat to sustainability as fuel reserves are limited, and increasing fuel use exacerbates the levels of greenhouse gases that hasten the effects of climate change. For these reasons, the **Global Fuel Economy Initiative (GFEI)** was established to initiate the discussion of developing policies that promote energy efficiency and fuel economy. GFEI has determined a global target of 50% improvement in fuel economy from a 2005 baseline by 2050 (50 by 50). As of 2014, GFEI reports that it is still far from meeting its target.

GFEI has worked with various countries from Africa, Asia and Latin America, and works closely with Clean Air Asia to promote fuel economy discussions in the Asian region. One of the roles of Clean Air Asia is to ensure that actions and interventions are adopted by governments in Asia to mitigate the contribution of the transport sector to fuel consumption. Clean Air Asia, through the support of the United Nations Environment Programme (UNEP), has worked with governments of the Association of Southeast Asian Nations (ASEAN) member countries in driving discussions towards developing fuel economy policies and standards at both national and sub-regional level. Through GFEI and UNEP support, Clean Air Asia has embarked on multiple discussions to elevate fuel economy as a policy agenda in the ASEAN sub-region by engaging key stakeholders, leading the discussions and providing technical assistance for establishing scientifically sound policy measures.

In the Philippines, Clean Air Asia was officially designated as the Secretariat for the Technical Working Group for Fuel Economy that has had ongoing discussions since early 2012. The Department of Energy hosted the policy dialogues that involved other government agencies such as the Department of Transport and Communications and the Department of Trade and Industry, with due participation from various stakeholders from the energy and vehicle manufacturing sectors. These stakeholders are expected to play important roles in the development and implementation of fuel economy policies and measures in the Philippines. Six meetings have been held since inception, the last of which was held in October 2013, where it was decided that there has to be an established baseline estimate for fuel economy in order to have basis for the policy dialogues within the Technical Working Group for Fuel Economy.

Scope and Objectives

Following the directive from the Technical Working Group, Clean Air Asia initiated the technical work for establishing the baseline fuel economy for the Philippines. This report aimed to establish the baseline fuel economy of new light duty vehicles (LDVs) that entered the Philippine market in 2013. Light duty vehicles for this purpose are defined as all passenger cars and light commercial vehicles (LCVs), classified as M1 and N1 according to Philippine vehicle classification by the Land Transportation Office (LTO), and not more than 3.5 tons in gross vehicle weight (GVW). The general objective for this study is to estimate the fuel economy and compare the performance of various vehicle segments with respect to baseline. By arriving at scientifically sound baselines, the researchers hope to provide the basis for policy discussions in the future.

Methodology

The methodology for baseline estimation adopts the prescribed estimator by the GFEI toolkit, using the harmonic mean fuel economy of the fleet of interest interpreted as the average fuel economy of registered vehicles at base year. Registration data was acquired from Segment Y, and a total of 731 LDV models were included in the estimation, consisting of 620 of passenger cars 111 LCVs. Data included vehicle models with information on GVW, engine displacement, gearing, and transmission, following the minimum data requirement of the GFEI methodology. Fuel economy is reported in liters of gasoline equivalent per 100 km (Lge/100 km) instead of liters per 100 km (L/100 km) for comparability. For the LDV fuel economy estimation, registration data was acquired from Segment Y.

Conclusion

Based on available data, the harmonic mean fuel economy of newly registered LDVs in the Philippines in the year 2013 is 7.8 Lge/100 km. Passenger cars perform better than baseline at 7.3 Lge/100 km while LCVs perform worse than baseline at 9.9 Lge/100 km. Diesel vehicles have a fuel economy above baseline at 10.3 Lge/100 km, while gasoline and hybrid vehicles have 6.3 and 4.5 Lge/100 km respectively. It is inferred that the demand for sedans, LCVs and multi-purpose vehicles (MPVs) shaped the fuel economy of the newly registered passenger cars in 2013, with the larger and less efficient vehicles driving the estimate up. Similarly, vans and pick-ups had the most shares of registrations and also influenced the fuel economy of LCVs.

This study does not determine which vehicles are better or worse. Rather, it provides an estimate of the baseline of the fuel economy as per available data, and then compares the fuel economy of the various segments with respect to the baseline. The results are only indicative of the real situation, and it is recommended to conduct controlled experiments to arrive at confirmative results.

LIST OF ABBREVIATIONS

ADMU	Ateneo de Manila University
AVID	Association of Vehicle Importers and Distributors, Inc.
ASEAN	Association of Southeast Asian Nations
CAA	Clean Air Asia
CAMPI	Chamber of Automotive Manufacturers of the Philippines, Inc.
CCC	Climate Change Commission
DENR	Department of Environment and Natural Resources
DENR-EMB	DENR – Environmental Management Bureau
DLSU	De La Salle University
DOE	Department of Energy
DOST	Department of Science and Technology
DOTC	Department of Transport and Communications
DTI	Department of Trade and Industry
DTI-BOI	DTI – Board of Investments
DTI-BPS	DTI – Bureau of Product Standards
GFEI	Global Fuel Economy Initiative
IEA	International Energy Agency
LCV	Light commercial vehicle
LDV	Light duty vehicle
LTO	Land Transportation Office
LTO-MIS	LTO – Management Information System
OECD	Organization of for Economic Cooperation and Development

TC44	Technical Committee 44
UNEP	United Nations Environment Programme
UPD	University of the Philippines – Diliman Campus
US EPA	United States Environmental Protection Agency

CONTENTS

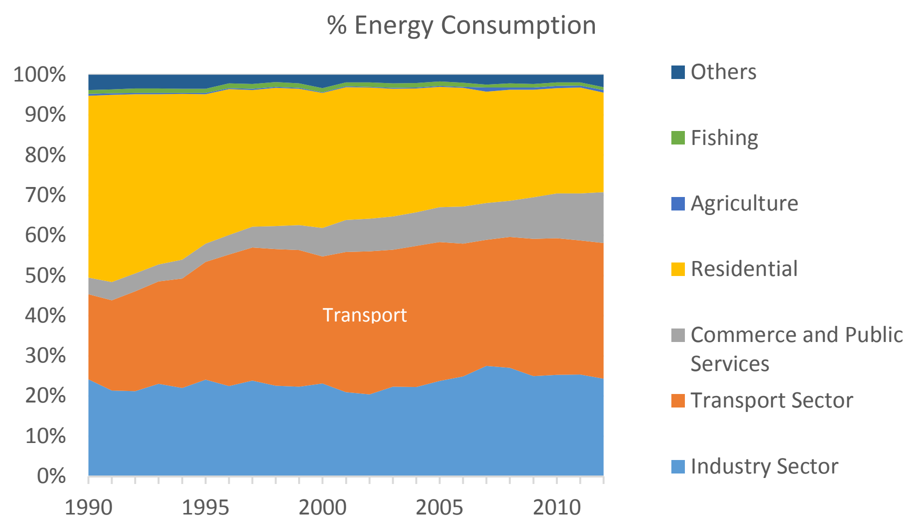
LIST OF FIGURES

LIST OF TABLES

I. Introduction

The rapid increase in global fuel consumption threatens sustainability as the reserves for fossil fuel are limited and are quickly diminished. For non-oil producing developing economies like the Philippines, fuel prices stagger economic growth as the trade balance tips to more fuel importation. The dependency of the country on imported fossil fuels creates an economic burden both at the macroeconomic level, at which fuel prices heavily impact the prices of goods and services and at the microeconomic level, where individuals and households remain dependent on fuel for day-to-day functions. Moreover, emissions from fuel combustion rapidly increase and exacerbate climate change and air pollution problems not only in the Philippines but all over the world too. As of 2010, 34% of the Philippines's energy consumption is from the transport sector.

Figure 1 - Energy demand per sector in the Philippines from 1990 to 2010



Source: IEEJ data

Due to the economic and environmental costs of fuel consumption around the world, reducing fuel dependency and consumption has become a necessary discussion and point of action across the globe. The Global Fuel Economy Initiative (GFEI)[1] was established in 2009 to promote research, discussion and action on vehicle fuel economy worldwide. GFEI has set global targets for vehicle fuel economy and as of 2011, GFEI reports indicate that it is still far from reaching 50% global reduction in liters per 100 kilometers by 2050 (50by50). Nonetheless, GFEI reports that fuel economy has been improving, but not fast enough.

[1] GFEI is a partnership between the United Nations Environment Programme (UNEP), FIA Foundation, International Energy Agency (IEA), the International Transport Forum (ITF), the University of California Davis (UCD), and the International Council for Clean Transportation (ICCT)

Table 1 - GFEI Global Targets for Fuel Economy

	2020	2030	2050
New Cars	30% reduction* in L/100km compared to 2005 Engines, drive- trains, weight, aerodynamics.	50% average improvement globally Hybridisation of most models.	50% + globally Significant contributions from Plug-in vehicles
Total fleet	20% reduction With lag time for stock turnover; includes eco-driving, maintenance	35% reduction	50by50

Fuel economy refers to fuel used relative to distance travelled (Fulton, 2014). The terms fuel economy, fuel efficiency, and fuel intensity are all interchangeable terms. Fuel economy is measured depending on which country is speaking, and what objectives are involved in terms of policy. For example, fuel economy is measured in liters per 100 km (l/100km) in Europe, kilometers per liter (km/L) in Japan, and miles per gallon (mpg) in the United States. Simply put, fuel economy is the rate of energy use.

This study aims to establish a baseline fuel economy estimate for new light-duty vehicles (LDV) that entered the Philippine fleet in the year 2013.[2] The research hopes to facilitate policy discussions by providing a scientifically-sound assessment of the fuel economy of new light-duty vehicles that enter the fleet.

II. Developing the National Fuel Economy Policies and Measures

Clean Air Asia (CAA) facilitated discussions on fuel economy policy development for the ASEAN member countries since 2012 as the strategic partner of GFEI for Asia. The discussions on fuel economy policy for the Philippines have been ongoing since 2012, with support from UNEP and GFEI. CAA functioned as the secretariat to a series of stakeholder meetings where representatives from transport and fuel sector were invited, including various government agencies mandated to deal with transport and fuel efficiency policies. Some international representatives from other governments and organizations were asked to share their experiences with fuel economy policies, such as Thailand and India.

A total of six workshop meetings were organized between 2012 and 2013. The first meeting was held in Malacañang Palace in January 2012 and was attended by representatives from the Department of Transport and Communications (DOTC), Department of Environment and Natural Resources – Environmental Management Bureau (DENR-EMB), Department of Energy (DOE), Department of Trade and Industry (DTI), Department of Science and Technology (DOST), Climate Change Commission (CCC) and the Senate. The private sector was represented by people from both the fuel retail and car retail industries. Also present were academic representatives from De La Salle University (DLSU), University of the Philippines – Diliman (UPD) and Ateneo de Manila University (ADMU). It was in this meeting that GFEI

[2] This study excludes two and three-wheelers.

together with CAA introduced the efforts being done on fuel economy policy at a global scale. In this meeting, it was decided that the DOE in coordination with DTI-BPS shall serve as the issuing body of the fuel economy standards.

A second meeting took place in 3 February 2012, hosted by the DOE. In this meeting, the DOE presented the proposed **National Energy Efficiency and Conservation Bill** (NEEC) and invited comments from the meeting participants. The draft bill is still being finalized in 2014.

Three more meetings occurred in 2012. During this time, CAA and UNEP invited foreign experts to share their experiences with developing fuel economy standards for their countries. An institutional framework has also been proposed before the participants, and discussions on institutionalization of fuel economy have long been underway.

The last meeting was held in October 2013 where the members of the committee decided to establish a Technical Working Group (TWG) on Fuel Economy which was to be led by Technical Committee 44 (TC44) of the Bureau of Product Standards in DTI. In this meeting, the participants decided that there is a need for data to establish fuel economy baselines that are science-based to support the development of the standards.

To help move the policy development forward, CAA initiated the technical work required to establish the baseline fuel economy estimation of newly registered passenger vehicles. This study aims to establish the baseline fuel economy of new LDVs in the Philippines during 2013 using available vehicle registration data. The baselines shall be used to support policy discussions for the development of fuel economy standards in the Philippines. The study results was initially presented to TWG representatives from government (Department of Energy) and private sector (Chamber of Automotive Manufacturers of the Philippines, Inc. or CAMPI). CAA will aim to resume the stakeholder discussions involving the rest of the TWG members as next step but largely depending on the policy direction of the Government of the Philippines.

III. Fuel Economy Policy in the Philippine Context

The Philippines has no fuel economy standards in place but there are policies that specifically target fuel economy improvement in general. The Department of Energy (DOE) has established a roadmap towards promoting energy conservation in various sectors. Two of the programs that indicate specific energy efficiency targets are the Philippine Energy Plan and the National Energy Efficiency and Conservation Program, and both programs include targets for the transport sector summarized below.

Philippine Energy Plan 2012-2030

The Philippine Energy Plan 2012-2030 governs the policies to be implemented that are in line with its thrust of ensuring energy security in the country. The PEP specifies plans and programs for the power generation sector, rural electrification, indigenous energy development, renewable energy, downstream oil industry, downstream natural gas, alternative fuels, and energy efficiency and conservation. The relevant targets and plans for transport include:

1. 10% energy savings on total annual energy demand of all economic sectors, including transport;
2. 30% of all public utility vehicles running on alternative fuels nationwide by 2030;
3. Natural gas as a major alternative fuel for public transport;
4. CNG refilling stations in Metro Manila and LNG Hub Terminals in Quezon; and
5. Promotion of fuel discounts and direct subsidies to public utility jeepneys and tricycle drivers.

National Energy Efficiency and Conservation Program

Alongside the implementation of the PEP is the National Energy Efficiency and Conservation Program (NEECP) which aims to promote efficient utilization of all forms of energy. The goal of this program is to achieve an average annual energy savings of 23 million barrels of fuel-oil-equivalent (MMBFOE) and 5.086 gigagram CO2 equivalent (GgCO2e) emissions avoidance for the period 2005 to 2014 (or a total of 229 MMBFOE for the entire period). This also translates to an avoidance of 50.9 million tons of CO^2 emissions for the same period.

IV. Scope and Objectives of Baseline Setting

The following are the objectives of the baseline setting on fuel economy:

1. To estimate from available data the baseline performance of fuel economy of the fleet of new light duty vehicles in the Philippines;
2. To compare the fuel economy of various vehicle segments with the baseline; and
3. To facilitate the development of fuel economy policies in the Philippines.

This study utilizes 2013 data on newly registered LDVs in the Philippines, which include passenger cars and light commercial vehicles (LCV) up to 3500 kg (3.5 tons) excluding two and three-wheelers. 2013 data was selected to arrive at the most up-to-date baseline estimate that closely characterizes the target vehicle segment currently in the market of the country.

V. Methodology

GFEI Methodology

This study uses the GFEI methodology as the basis for data collection and estimation. The GFEI uses 2005 as the baseline year, and recommends collection of 2008 data and every 2 years thereafter. The methodology requires a minimum set of data as follows:

- Vehicle make and model, and if possible “configuration” (this typically is labeled by the manufacturer using a sub-model number or other designation; it can indicate transmission type, trim level, optional accessories, etc.)
- Model production year
- Year of first registration, if different from model year
- Fuel type

- Engine size
- Domestically produced or imported
- New or second hand import
- Rated Fuel Economy per model and test cycle basis. This can be done either by getting data from country of origin or manufacturer (see Resources section below for links), or by testing of a select sample of vehicles.
- Number of sales by model

In summary, the baseline-setting exercise includes the following steps:

1. Establish the baseline year (e.g. the GFEI uses 2005)
2. Establish the data points you will need to collect in order to calculate a robust baseline
3. Find and evaluate available new LDV vehicle registration data sources and their quality
4. Calculate your baseline year average fuel economy and other characteristics for newly registered vehicles; and
5. Repeat the same exercise using uniform methodology at regular intervals.

The GFEI prescribes the harmonic mean fuel economy as the fleet-wide estimator to characterize the fuel economy of new vehicles that enter the market at base year. The equation is shown in the section on Fuel Economy Estimation and Interpretation. This methodology has been adopted by other countries such as Kenya, South Africa, Indonesia, and Chile. For the Philippines, the researchers selected 2013 as the base year to utilize the most updated and complete data that reflects the current vehicle technology.

For more information on the GFEI methodology, visit www.unep.org/transport/gfei/autotool.

Data Challenges and Limitations

Publicly available data on vehicle sales or registration segmented over specific attributes is very sparse in the Philippines. The Land Transportation Office (LTO) is the national government agency responsible for vehicle registration and its Management Information System (MIS) department compiles vehicle registrations across the region and subsequently publishes the aggregated counts of all registrations annually. However, the published data contains total vehicle registrations segmented only by fuel type, vehicle type, new and renewals, and type of ownership, as well as information on unit value. In addition, the LTO classifies vehicle fuel type into diesel and gasoline only, and it is unclear how vehicles running on alternative fuel, i.e. electric and hybrid vehicles are classified. In general, the LTO does not report other details of the registration it deems confidential, and further disaggregation of the data is not available. Moreover, digital copies of the officially published data are not accessible and difficult to acquire. Available LTO data cannot supplement the data needs of the fuel estimation method adopted from GFEI, thus the need to look for data from other sources.

The research team also requested data directly from the car manufacturers and dealers particularly from the Chamber of Automotive Manufacturers of the Philippines, Inc. (CAMPI) and the Association of Vehicle Importers and Distributors, Inc. (AVID). Disaggregated sales data based on the requirements of the GFEI methodology were requested from car manufacturing companies and associations to ensure that the process is consultative. However, requesting for the data from the private sector proved to be a challenge, and with limited time and resources, other options had to be considered.

As a last resort, Segment Y data was acquired for use in the baseline setting activity. Segment Y Automotive Intelligence Pvt. Ltd. is a Dutch owned and managed company based in India that focuses on automotive markets in Asia (Segment Y, 2015) and quality vehicle data is among its many research products. The limitation of Segment Y data is that it is very difficult to validate. Also, the presence of a "grey market" (unregistered vehicles) creates uncertainty when generalizing the data fuel economy with that of the whole Philippine fleet. Another limitation is that the vehicle classification used by Segment Y does not compare with the official statistics. It is also important to note that the fuel economy values used in the estimation process refer to the rated (tested) fuel economy (fuel economy based on prescribed international testing standards and procedures) and may not necessarily reflect the on-the-ground fuel economy of the specific registered vehicle.[3] Segment Y provides urban, extra urban and combined rated fuel economy, and the baseline estimation utilizes the combined fuel economy of the included models. Despite this, Segment Y is internationally renowned for its vehicle data and research products, and for the Philippine data, Segment Y claims confidence in knowing of the uncertainties involved with the data they provide.

Data Profile

The data from Segment Y contained new vehicles registered for a combination of vehicle models and versions per vehicle type. The attributes requested from Segment Y are the minimum set of information recommended by GFEI for fuel economy baseline setting. Segment Y acquires information directly from vehicle manufacturing companies and in the Philippines and car manufacturing associations such as the CAMPI and AVID, as well as independently conducted market studies.

Each row corresponds to a specific model and version of the model. Segment Y data contains the fields shown in Table 2 - Fields included in the Segment Y data, and the definitions of these fields are provided in Annex 1: Field Definitions for Segment Y Data. A total of 731 vehicle models were included in the data, 620 of which were passenger cars and 111 are LCVs (

Table 3).

Table 2 - Fields included in the Segment Y data

Serial No.	Body style
Data type	Transmission type
Country	Gears
Vehicle type	Number of Cylinders
Segment-global	Engine Displacement (cc)
Data source	Fuel type
Production year	Urban
Make	Extra Urban
Model	Combined
Version	Norm

[3] This approach follows the guidance of the GFEI methodology.

Model code	Gross Vehicle Weight (GVW)

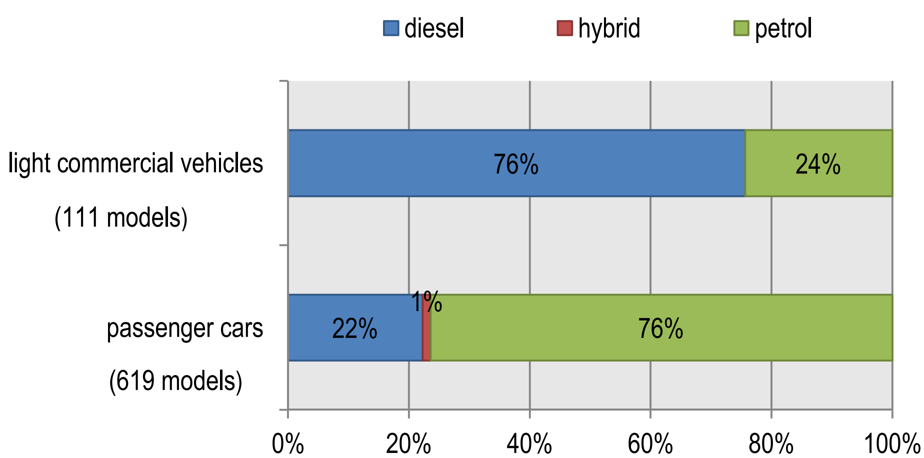
Table 3 - Data counts for models of newly registered vehicles in 2013 data

Vehicle Type	No. of Models in Raw Data	Percent
passenger cars	620	85%
light commercial vehicles	111	15%
TOTAL	731	100%

Source: Segment Y 2013

Out of the 620 passenger car models, the Mitsubishi i is an electric vehicle with no tested fuel economy and is removed from the dataset of interest. Thus, 619 passenger car models are included alongside the 111 LCV models for baseline analysis. The distribution by fuel type of passenger car and LCV models is shown in Figure 2.

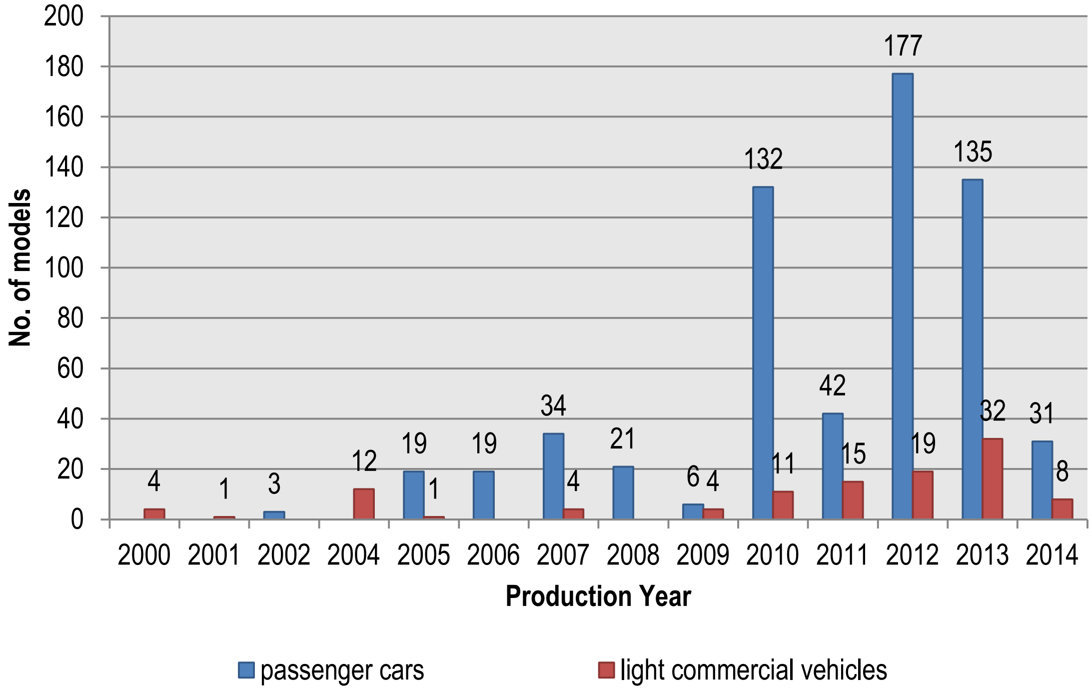
Figure 2 – Data distribution of passenger car models by fuel type



The mix of models is highly varied based on production year. Most of the passenger car models have production years 2010 onwards, but there are quite numerous models produced before 2010 even as far back as 2002 which would have been 11 years old in 2013. Newly registered LCV models reach as far back as 2000, which would have been 13 years old in 2013.

The number of models per production year is plotted in Figure 3.

Figure 3 - Number of models by production year



To be comparable with LTO definitions, vehicle gross vehicle weight (GVW) was categorized using LTO-MIS guidelines under a new variable named "Weight Class". As seen in Table 4 most models in the data are medium-weight vehicles.

Table 4 - Number of LDV models per weight class based from LTO definitions

	LTO Definition	No. of PC models	No. of LCV models
Light	up to 1600 kilograms	126	9
Medium	1601-2300 kilograms	339	16
Heavy	more than 2300 kilograms	154	86
TOTAL		**619**	**111**

Fuel Economy Estimation and Interpretation

The baseline estimation utilizes the prescribed methodology by the UNEP using a harmonic mean of fuel economy as shown in the following formula:

$$Harmonic\ mean\ fuel\ economy = \frac{Total\ sales\ of\ the\ year}{\sum_1^n \frac{sales\ model\ i}{fuel\ economy\ model\ i}}$$

The harmonic mean controls for the high variability in tested fuel economy between each model and vehicle weight class. Generally, the harmonic mean is preferred for estimating rates, i.e. fuel economy, for a certain population. For the Segment Y data, the sales variable is replaced by number of new registrations which represents the population of new vehicles that enter the Philippine market in 2013. This allows for policy basis for fuel economy standards of new vehicles.

Segment Y reports fuel economy in liters per 100 kilometers (L/100 km). In order to make the values comparable across the fleet (and across fuels), the fuel economy of each observation was converted to liters gasoline equivalent per 100 kilometers (Lge/100 km). [4]

The harmonic mean fuel economy in this methodology is interpreted as the average liters of fuel (converted to Lge) that would be consumed per distance traveled by the vehicles registered at base year. The higher the value, the less efficient the vehicle and vice versa.

The limitation of this method of estimation is that it utilizes the fuel economy rated from the country of manufacture as opposed to locally tested fuel economy. This means that the figures may not reflect localized conditions particularly local drive cycles and ambient conditions. There is no facility that conducts laboratory testing in the Philippines and according to IEA the difference between rated and real-world fuel economy can reach up to 10%.

Data Uncertainty

Since Segment Y data acquires what car manufacturers and dealers can and would provide, it is uncertain whether the models are exhaustive of every model in the market at base year. Despite this concern, Segment Y is certain that none in the private sector would underreport, and that most of the uncertainty would come from vehicles from grey imports.

LTO data was acquired for supporting analysis and comparison with the available Segment Y data. LTO is the authority on vehicle registration in the Philippines, and the agency compiles annual registration counts. The challenge with comparing LTO data with Segment Y data lie in understanding the vehicle classification. The LTO does not use the same segment definitions as Segment Y, as can be seen between Annex 2: and

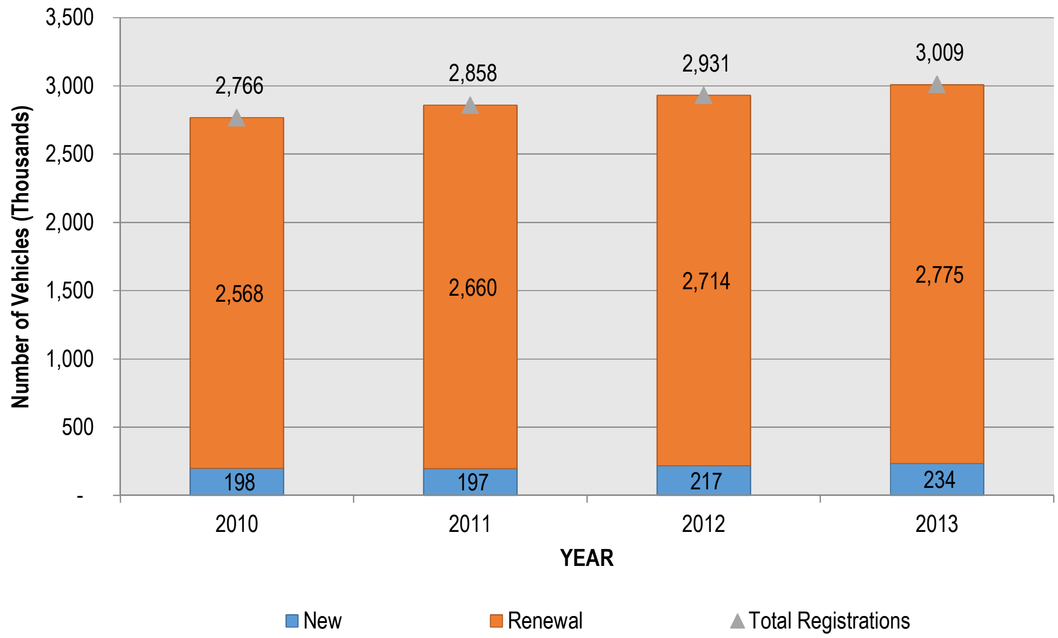
[4] Assumptions are based on conversion factors by the Massachusetts Institute of Technology (MIT)

Annex 3: LTO Classification of Motor Vehicles.

Comparing with Official Statistics

Figure 4**Error! Reference source not found.** shows LTO registration counts from 2010 to 2013, which are official statistics culled from the LTO compilation. Cars, SUVs and UVs are counted as LDVs based from LTO classification, and details of this classification are shown in Annex 3. As seen from the data, the number of new registrations of LDV grew by 18% between 2010 and 2013 or an average of 4.5% per year. New registrations in 2013 account for about 8% of the total, or 234,000 newly registered LDVs.

Figure 4 - Total number of registrations from 2010 to 2013



Of the 234 thousand newly registered vehicles, 49% are classified as utility vehicles (UV). It is apparent from this data that there is a gap between LTO and Segment Y at 234 thousand and 160 thousand new registrations respectively. Segment Y data includes 77,279 cars (hatchback, sedan, coupe, etc.), 47,722 SUVs, and the remainder amounts to 81,482 (light trucks and vans, MPVs, pickups, etc.). The reason is that the UVs according to LTO classification include bigger vehicles larger than 3.5 tons (Segment Y's cutoff for passenger cars). These include transport jeepneys, remanufactured jeepneys, etc. The remainder of the gap with official data comes from the "grey importers" which are not included in Segment Y data.

Table 5 - Number of New Registrations of LDVs as per LTO classification, 2013

Vehicle Type	Number of New Registrations	Percent
Cars	73,651	31%
SUV	46,535	20%
UV	113,872	49%
TOTAL	**234,058**	**100%**

Utility vehicles (UV) compose half of the LDVs newly registered in 2013. 149,386 newly registered LDVs or 64% across the Philippines in 2013 are from the National Capital Region (NCR), as can be seen in Table 7.

Table 6 - Regional comparison of new LDV registrations in 2013

Region	No. of new registrations	Percent
1	2456	1.05%
2	2625	1.12%
3	13,434	5.74%
4	8427	3.60%
5	1032	0.44%
6	7106	3.04%
7	14,631	6.25%
8	832	0.36%
9	7998	3.42%
10	4591	1.96%
11	5440	2.32%
12	14,779	6.31%
CAR	719	0.31%
CARAGA	602	0.26%
NCR*	149,386	63.82%
Grand Total	234,058	100.00%

Analytic Methods

The fuel economy of a vehicle is determined by several technical attributes. Three of the top factors that contribute to fuel economy are: displacement, weight, and gearing (GFEI). These three factors are among the minimum data requirements of the GFEI methodology and are considered in the analysis. Other factors include aerodynamics, induction, intake and exhaust, rolling resistance, mechanical resistance, altitude and temperature.

To better understand the implication of the baseline fuel economy of the fleet, the various vehicle models are categorized into segments. The fuel economy of each segment is computed using the same methodology for comparison with the baseline. Basic plots and charts are provided for visualization, and the comparison between segments is plotted as box plots to show the data spread, outliers and extremes within each segment.

The baseline analysis is purely comparative in nature, and no causal relationship can be established with the data at hand. All the results are only indicative of any relationship, and further investigation with proper data is recommended.

VI. Results and Analysis

Summary Statistics for LDVs in the Data

This section presents the descriptive summary statistics of passenger cars and LCVs. The minimum, maximum and average values are shown alongside measures of variation to characterize the models included in the data.

Gross Vehicle Weight (GVW)

Weight is one of the factors that determine how hard the engine should work to provide power to the vehicle. The average weight for all LDV model in the data is 2104 kg. Passenger cars average at 2028 kilograms across all newly registered models in 2013, while LCVs are heavier on average at 2526 kilograms. Figure 5 provides a visual comparison of GVW across all LDVs and of passenger cars and LCV. Summary statistics are provided in Figure 5 - Comparison of GVW averages of LDV models, overall, passenger cars and light commercial vehicles

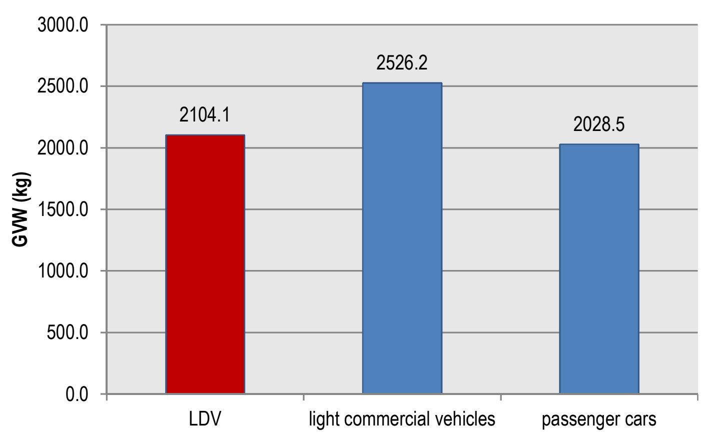


Table 7 and

Table 8 with LTO weight classes as segmenting variable. A histogram of the GVW is shown in Figure 6 and it shows that vehicle weights of the newly registered passenger cars lean towards the light to medium spectrum.

Figure 5 - Comparison of GVW averages of LDV models, overall, passenger cars and light commercial vehicles

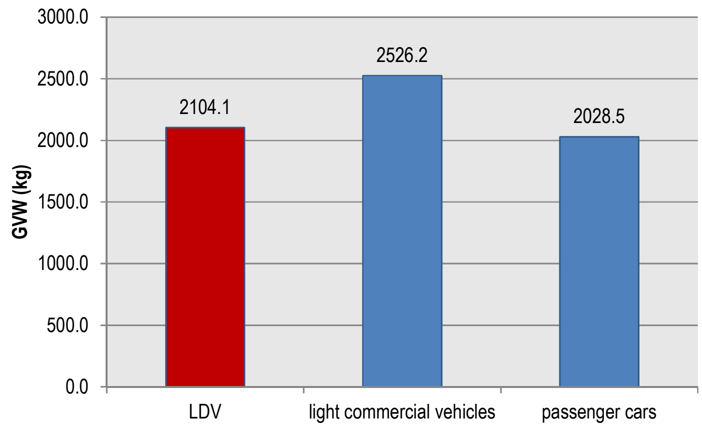


Table 7 - Summary Statistics for GVW of passenger cars

Weight Class	No. of models	Low GVW (kg)	High GVW (kg)	Average GVW (kg)	Std. Dev	Coefficient of variation
Light	126	1150	1600	1446.9	116.7	8%
Medium	339	1608	2300	1956.9	205.1	10%
Heavy	154	2305	3502	2661.9	269.0	10%
Passenger cars	619			**2028.5**	464.1	23%

Table 8 - Summary Statistics for GVW of light commercial vehicles

Weight Class	No. of models	Low GVW (kg)	High GVW (kg)	Average GVW (kg)	Std. Dev	Coefficient of variation
Light	9	1400	1600	1440	70	5%
Medium	16	1615	2150	1816.9	153.4	8%
Heavy	86	2370	3200	2771.8	193.4	7%
Light commercial vehicles	**111**			**2526.2**	**499.3**	20%

Figure 6 - Histogram of GVW for newly registered LDV models in 2013

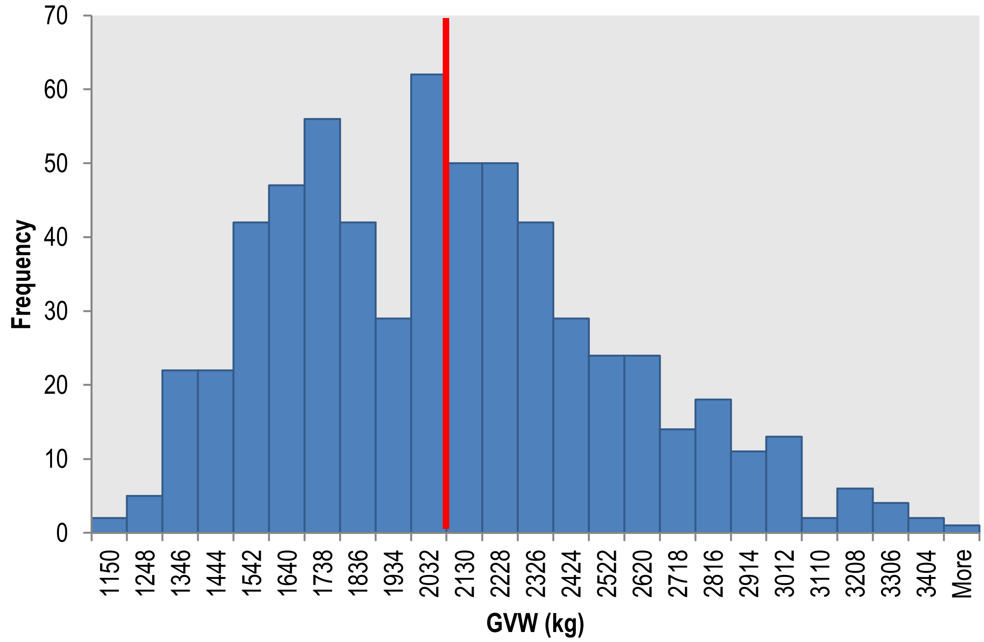
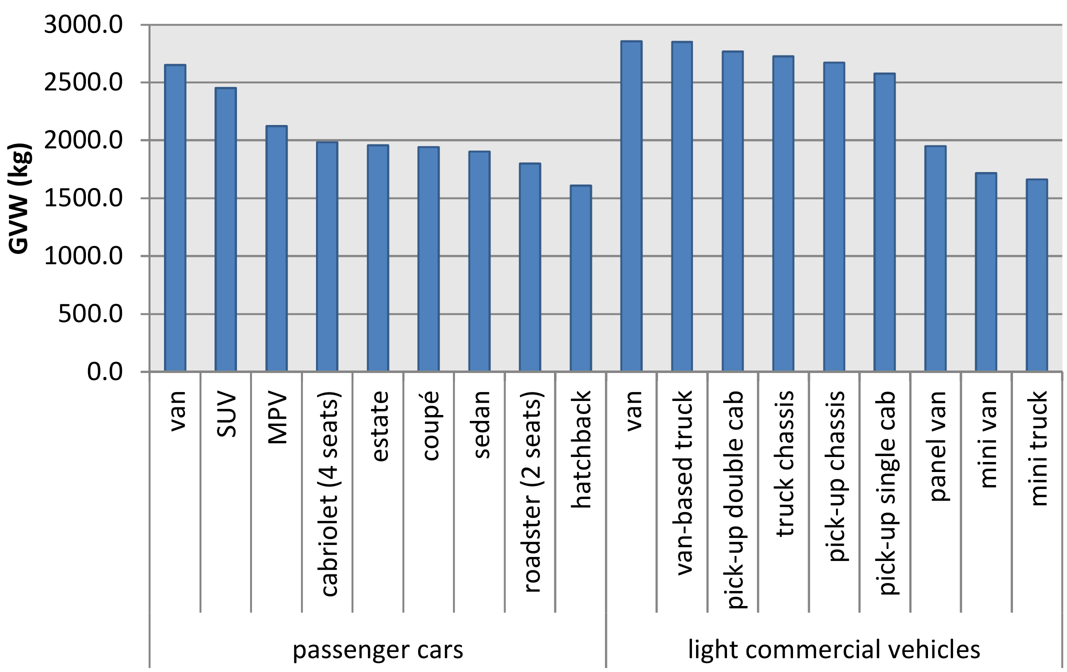


Figure 7 is a chart of the average GVW of each body type of LDVs. Among passenger cars, SUVs and MPVs weigh above average GVW, while sedans weigh below average GVW. For LCVs, vans are the heaviest and the mini trucks are the lightest. Overall LDVs, vans have the highest average GVW while hatchbacks have the lowest average GVW.

Figure 7 - Average GVW per body type of LDV models



Engine Displacement

Engine displacement is the volume swept by all the pistons inside the cylinders of a reciprocating engine in a single movement from top dead center (TDC) to bottom dead center (BDC). Holding all other things constant, larger engines tend to make more horsepower because they can naturally move more air per revolution, requiring more fuel to generate such power. The unit for engine displacement is cubic centimeters (cc), and is an indicator of the engine's size and power based on the volume of its cylinders. The average engine displacement of the models is 2395 cc. For comparability, engine displacement of each model was categorized according to the study by IEA and GFEI. Table 9 provides summary statistics for engine displacement and it shows that there is low variation within each category. Table 10 provides the engine displacement averages based on weight class, showing high variation in engine displacement of each class.

Table 9 - Summary statistics for engine displacement of LDVs

Engine Displacement Category	No. of models	Min CC	Max CC	Average CC	Std Dev	Coefficient of variation
Less than 800	4	796	796	796.0	0.0	0%
800-1200	35	812	1199	1063.5	121.1	11%
1200-1600	204	1206	1598	1470.0	120.1	8%
1600-2000	132	1685	1999	1946.1	88.3	5%
2000-2400	49	2143	2400	2269.3	92.5	4%
2400-2800	119	2402	2793	2549.1	111.1	4%
2800-3200	73	2902	3200	2999.8	62.6	2%
Greater than 3200	114	3342	6749	4485.0	1027.3	23%

Table 10 - Summary of engine displacement per weight class

Weight Class	No. of Models	Min CC	Max CC	Average CC	Std Dev	Coefficient of Variation
Light	135	796	1997	1321.9	217.4	16%
Medium	355	999	6424	2293.23	1022.4	45%
Heavy	240	1809	6749	3122.7	1052.9	34%

Supporting analysis is shown in Figure 8 and Figure 9. The histogram shows how widely spread the engine displacement is across the models. Closer examination of the engine displacement of each model shows that the coupé has the highest spread of engine CC compared to the other body types, and on average have larger engine displacement. In contrast, hatchbacks have smaller spread and lower engine displacement on average. Figure 9 shows the average engine displacement per body type, where the coupe has the highest engine displacement among passenger cars and LDVs while the mini-vans have the lowest engine displacement among LDVs.

Figure 8 - Histogram of engine displacement across LDV models

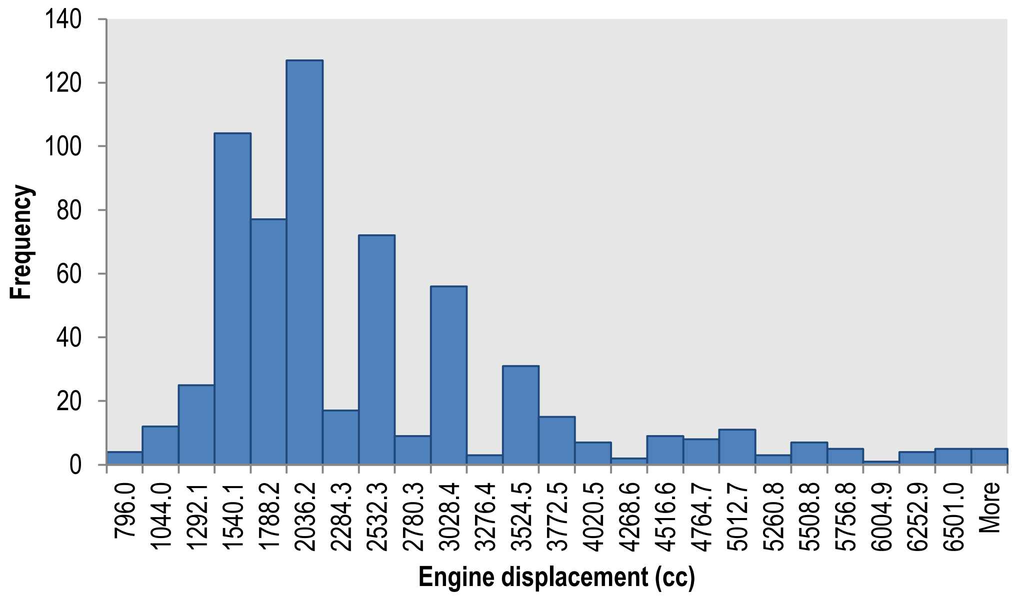
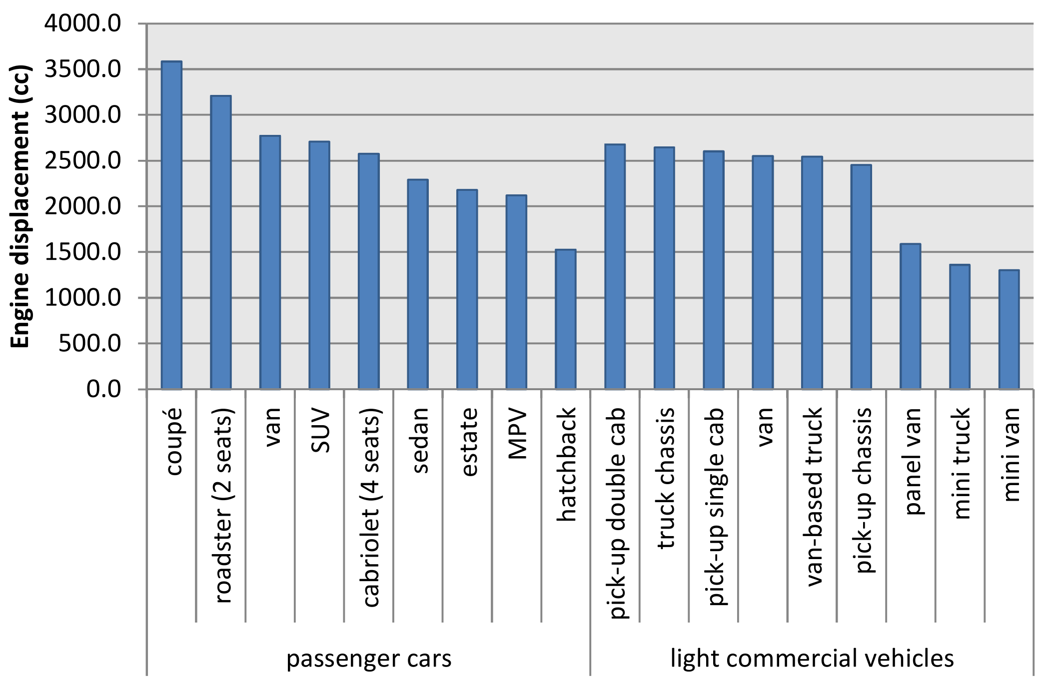


Figure 9 - Average engine displacement per body type of LDV models



Segments

New registrations represent the vehicles that enter the market. A vehicle's demand is based on certain specifications that meet the needs of the buyer, creating different market segments. The baseline can be understood better by looking at the distribution of registrations and the fuel economy of the various segments. The segments are identified as follows:

- Weight class
- Fuel type
- Body type
- Gearing
- Transmission type

Figure 10 shows the distribution of newly registered LDVs in 2013, where 78% of registrations were passenger cars. Further disaggregation is shown in Figure 11, where the share of registrations per weight class is shown for each LDV type. The chart shows that Light to Medium-sized vehicles dominated the passenger car market in while Heavy-sized vehicles led the LCV market in 2013.

Figure 10 - Distribution of newly registered LDVs in 2013

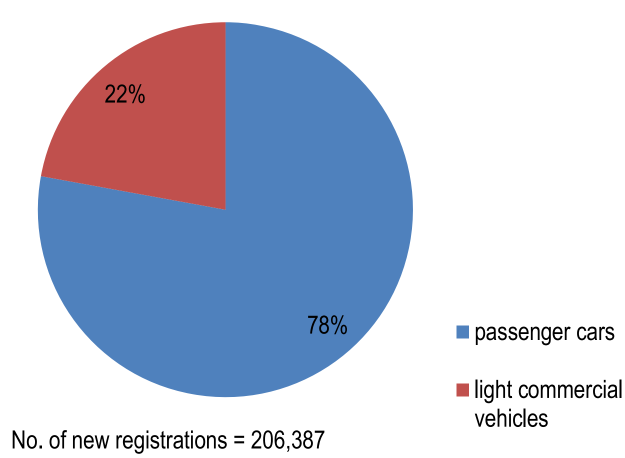


Figure 11 - Distribution of new registrations per vehicle type by weight class

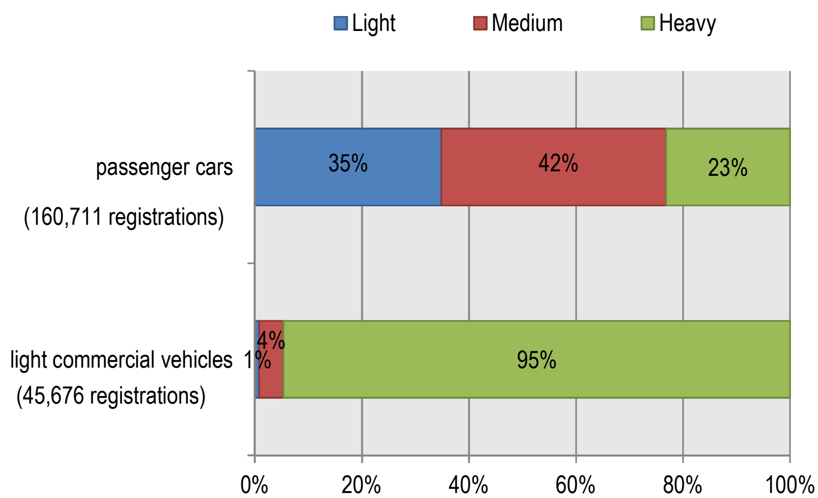
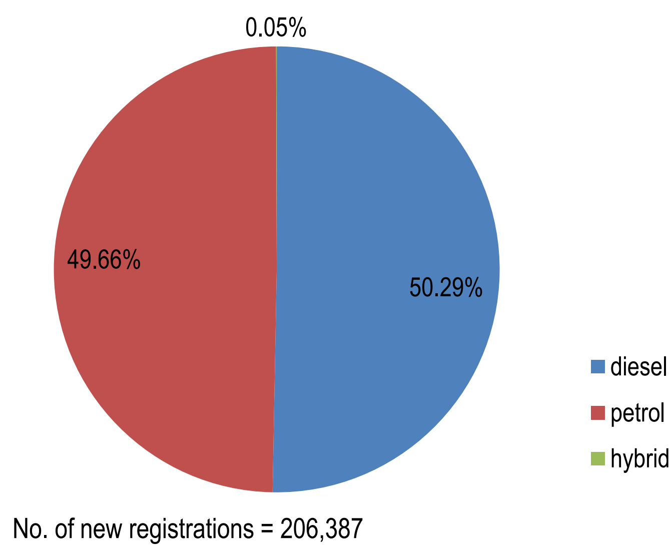


Figure 12 presents the share of new registrations per fuel type, and it shows that there is a nearly equal share of diesel and gasoline vehicles. There were a small number of hybrid vehicles running on regular unleaded gasoline that were in the registration data. The fuel type is one of the determinants of emissions and would be useful for converting L/100 km to Lge/100km and gCO_2/km.

Figure 12 – Shares of newly registered LDVs per fuel type



Since passenger cars and LCVs have different markets and functions, the market segments of the two types of LDV are presented in cumulative charts below. For passenger cars, sedans, SUVs and MPVs had the most number of new passenger car registrations in 2013 which when combined composes about 84%

of the newly registered passenger cars as can be seen in Figure 13. For LCVs, the pick-up double truck and the van had the largest combined share of registrations at 84% as seen in Figure 14.

The figures indicate that majority of passenger cars that entered the Philippine market in 2013 favors the type of vehicles generally preferred by families and the working class. Sedans are generally cheap small cars made easily accessible through car loans and low tax rates. This is in line with the analysis conducted by IEA and GFEI (OECD/IEA, 2011) in which they indicated that developing countries favor small to mid-sized cars as the car for all-around car use. The dominance of these car types directly impact the fleet-wide fuel economy.

On the other hand, it is difficult to deduce the reason for the dominance of pick-ups and vans among newly registered LCVs. There is no information on the function where the specific models are utilized, and for better understanding of the freight baselines, it is recommended to further study how these vehicles are typically used.

In the succeeding sections, the fuel economy estimates of each market segment would allow a realization of the performance and implications on fuel consumption of passenger cars sold in the country.

Figure 13 - Cumulative percentage of newly registered passenger cars by body type

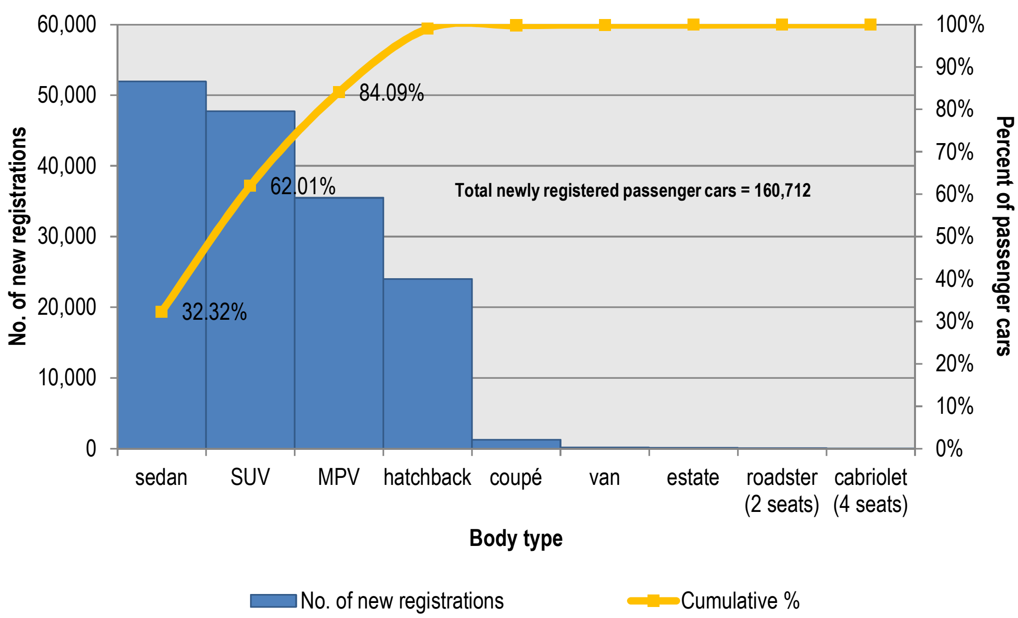
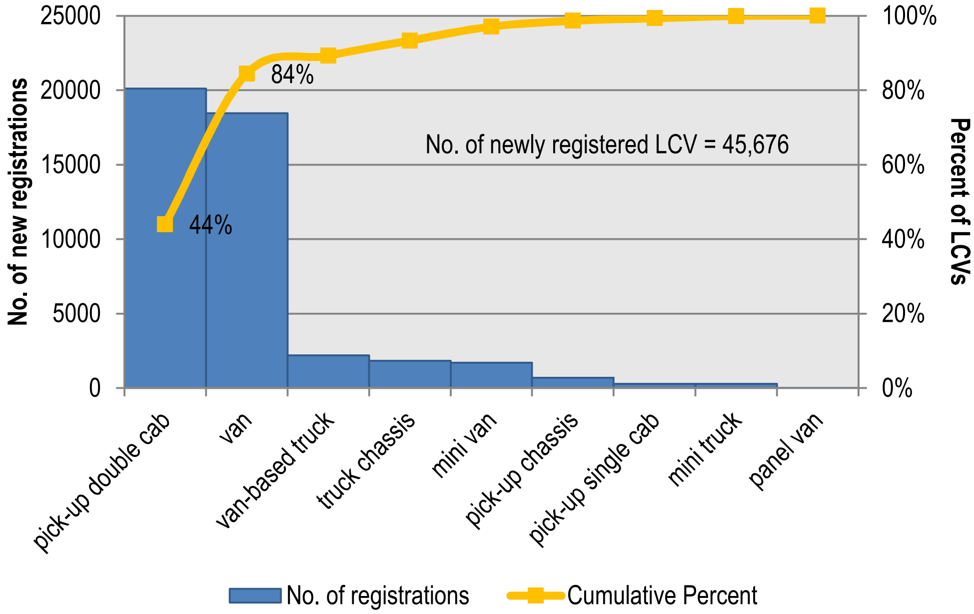


Figure 14 - Cumulative percentage of newly registered LCVs by body type



Aside from weight and engine displacement, the distribution of registered vehicles based on gearing and transmission type also provides further insights to market preference. Gearing is the base feature that determines how the vehicle is maneuvered on the road. In terms of fuel economy, the basic system that converts engine revolutions into rolling tires is transmission, and the number of gears determines how efficient the engine provides more speed to the vehicle when driving. Figure 15 and Figure 16 show the shares of registration by gear and transmission type. Figure 15 indicates that most LDVs newly registered in 2013 are 5-speed cars, while Figure 16 indicates that there is more or less an equal share of manual and automatic transmission car among new registrations.

Figure 15 - Percent of new registrations by number of gears of LDVs

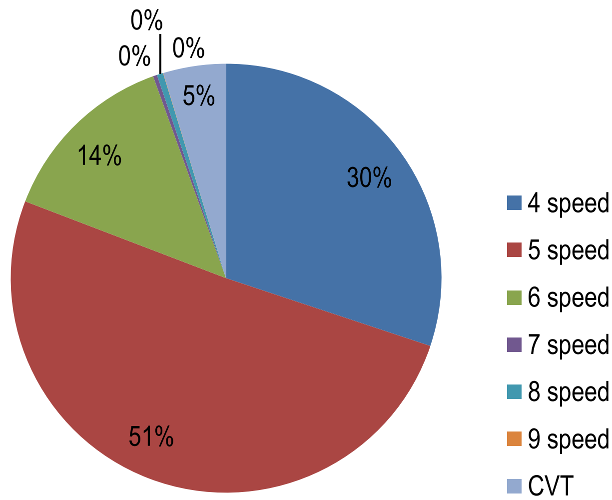
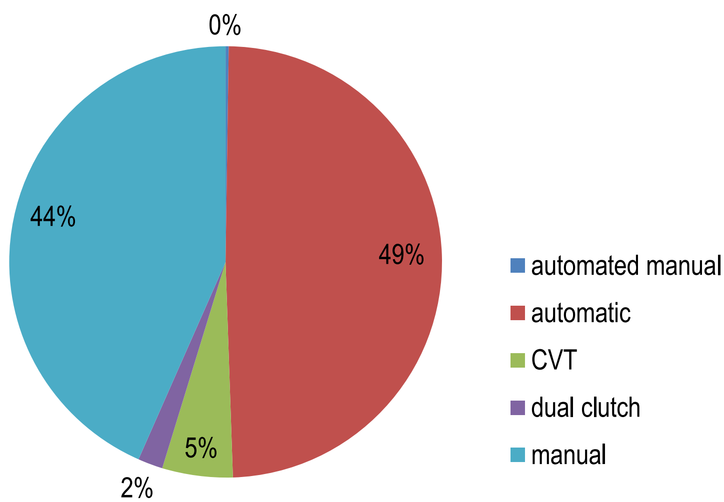


Figure 16 - Share of new registrations per transmission type



Correlation Analysis

There is evidence of correlation between the tested fuel economy, engine displacement and the gross vehicle weight (GVW) of models in the data. This can be seen in the correlation matrix provided in Table 11. The tested fuel economy seems to be highly correlated with engine displacement, and moderately correlated with gross vehicle weight when looking across the models in the data. Engine displacement and gross vehicle weight are also moderately correlated.

Table 11 - Correlation Matrix for fuel economy, GVW and engine displacement

	Combined Fuel Economy	Gross Vehicle Weight	Engine Displacement
Combined Fuel Economy	1	0.62	0.80
Gross Vehicle Weight (GVW)	0.62	1	0.68
Engine Displacement	0.80	0.68	1

Fleet-wide Fuel Economy Estimates

Using the harmonic mean over number of registrations, the fleet-wide fuel economy estimates for each vehicle type were computed as seen in Table 12 below. The computations are based on the combined tested fuel economy of each vehicle model (weighted average of urban and extra-urban fuel economy). Based from the new registrations of Segment Y data, LDVs have an average fuel economy of 7.8 Lge/100 km. A disaggregation by fuel type for each vehicle type is also provided.

Table 12 - Final estimates on fuel economy for newly registered LDVs in the Philippines during 2013

Vehicle Type	Highest FE (Lge/100 km)	Lowest FE (Lge/100 km)	Harmonic Mean FE (Lge/100 km)
Light duty vehicles			7.8
Diesel			10.3
Gasoline			6.3
Others			4.5
Passenger cars	**2.5**	**16.8**	**7.3**
Diesel	4.7	13.4	9.9
Gasoline	3.8	16.8	6.2
Others	2.5	8	4.5
Light commercial vehicles	**5.9**	**13.9**	**9.9**
Diesel	6.7	13.9	11.2
Gasoline	5.9	12.5	9.4
Others	none	none	None

To see the performance of the harmonic mean as an estimate, the arithmetic mean[5] and the 5%, 10% and 20% trimmed means[6] are provided in Table 13. Note that the additional estimates are based on the tested fuel economy of the models in the data. The table shows that the harmonic mean fuel economy is lower than the other estimates, implying that models with higher registrations must have low (better) Lge/100 km. Since the harmonic mean is based on registrations, the implication is that majority of new passenger car models registered in 2013 tended to be more efficient than average, thus pulling the fleet-wide harmonic mean down. In contrast, the harmonic mean fuel economy for LCVs seems to indicate low efficiency of new registrations.

[5] The arithmetic mean is the basic average (sum of observations over number of observations).
[6] The M% trimmed mean is computed by removing M% of the sorted data points (array) from the top-most and bottom-most values. It is a means of checking for the robustness of estimates in the presence of extreme values and outliers.

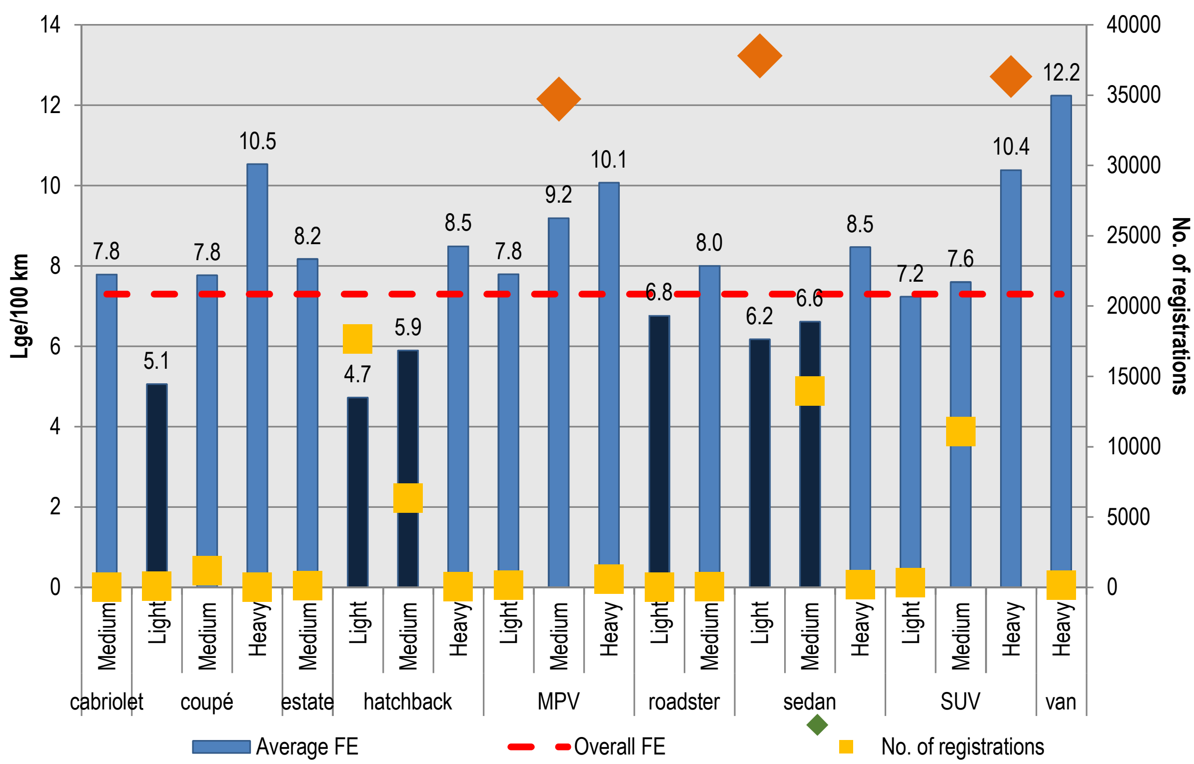
Table 13 - Comparison of the harmonic mean with the trimmed mean and the median fuel economy estimates

Vehicle Type	Harmonic Mean FE (Lge/100 km)	Median FE (Lge/100 km)	Arithmetic Mean FE (Lge/100 km)	5% Trimmed Mean FE (Lge/100 km)	10% Trimmed Mean FE (Lge/100 km)	20% Trimmed Mean FE (Lge/100 km)
passenger cars	7.3	7.6	8.0	7.9	7.8	7.8
light commercial vehicles	9.9	10	9.2	9.2	9.2	9.3

Fuel Economy and Vehicle Weight

The fuel economy for each body type was estimated by weight class based from the LTO-MIS guidelines. Separate baseline comparison for LCVs and passenger cars are provided. Figure 17 shows a baseline comparison for the passenger cars by weight class. It can be seen from the chart that almost all the light-weight body types fall below average Lge/100 km, or in general are more efficient than baseline. Light and medium sedan models on average perform better than the baseline at 6.2 and 6.6 Lge/100 km respectively. Similar to sedans, low and medium hatchbacks seem to perform better than most of the other body types.

Figure 17 - Fuel economy of passenger cars by weight class per body type



A similar chart was constructed for LCVs as Figure 18. It is apparent from the chart that the heavy body types fall above baseline for LCVs (9.9 Lge/100 km). The number of registrations was dominated by heavy pick-ups and vans, thus pulling the harmonic mean up for LCVs. Only the mini-truck, mini vans and panel vans fall below the average Lge/100 km – these body types are more efficient than both LCV baseline and the overall LDV baseline of 7.8 Lge/100 km.

Figure 18 - Fuel economy of LCVs per body type by weight class

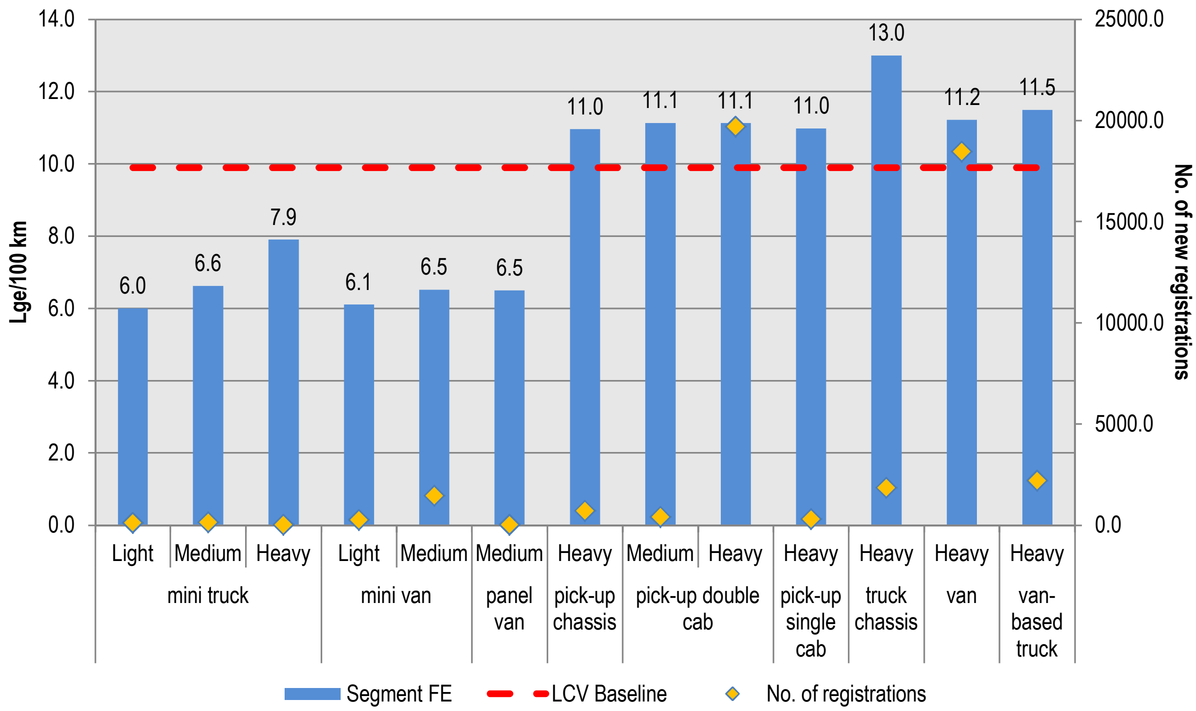
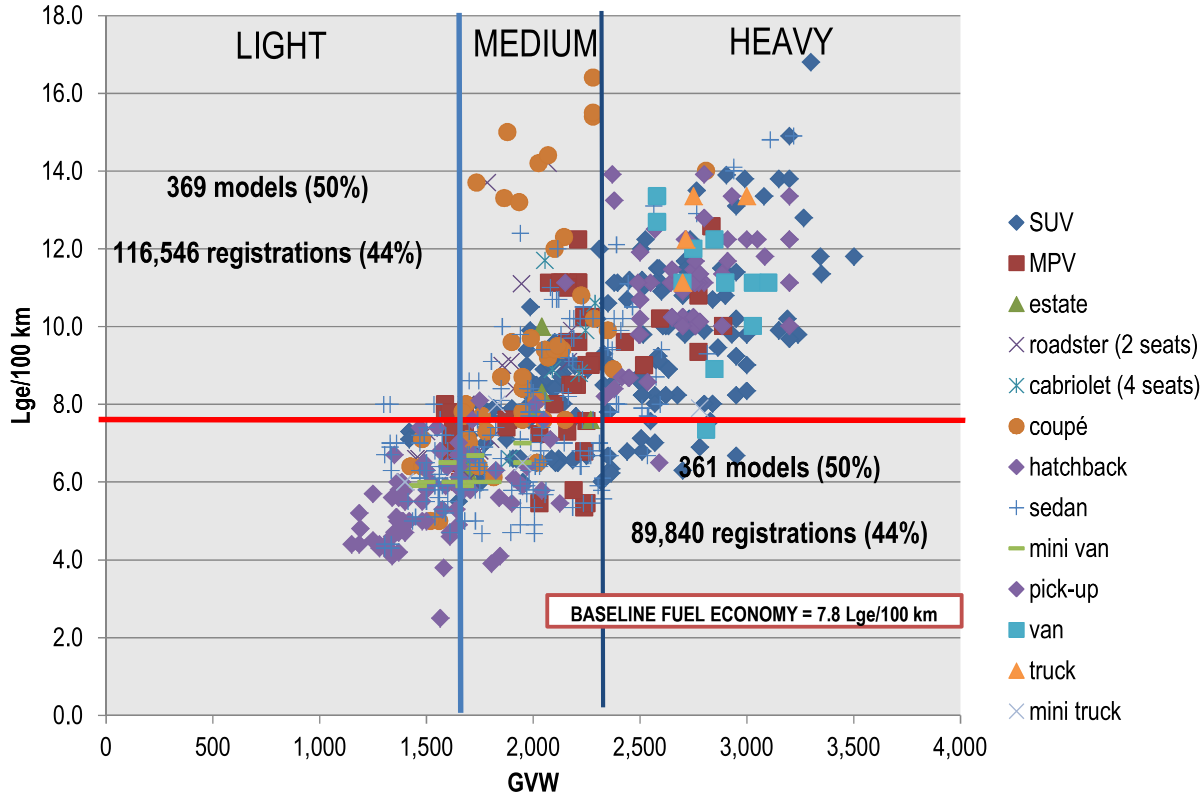


Figure 19 is a scatter plot to show where the fuel economy of each model lies with respect to the baseline estimate. Segmentation by weight class is provided for visual comparison. It can be seen that although half of the LDV models have indicated fuel economy above the baseline of 7.8 Lge/100 km, only 44% of the new registrations perform better than baseline. **It seems that based on the data, vehicles with higher GVW have higher Lge/100 km.** This can be seen from the LCV models above the baseline. The highest (least efficient) rated fuel economy among the models is 16.8 Lge/100 km and the lowest (most efficient) is at 2.5 Lge/100 km.

Figure 19 – Scatter diagram of fuel economy and GVW among vehicle models with respect to baseline for LDVs



Fuel Economy and Engine Displacement

Figure 20 is a chart of the fuel economy estimates per engine displacement segmented according to the GFEI methodology. The plot shows a clear relationship between fuel economy and engine displacement, although further investigation must be done to establish this relationship. Nonetheless, based from data, vehicles with higher engine displacement have higher Lge/100 km, meaning higher displacement results in less-efficient vehicles. Vehicles with engine displacement above 1600 cc represented in the data have Lge/100 km above the baseline.

A scatter plot similar to Figure 19 is provided (Figure 21) with lines marking the delineation between each engine displacement category. The individual observations show that for passenger cars, models with body type as coupes and SUVs are the body types with above average Lge/100 km, indicating less efficiency compared to baseline. Similarly, vans and pick-ups lie above baseline, although these body types have mid-range engine displacement but as shown in the previous scatter diagram, these body types have heavier GVW.

Figure 20 - Fuel economy by engine displacement category of LDVs

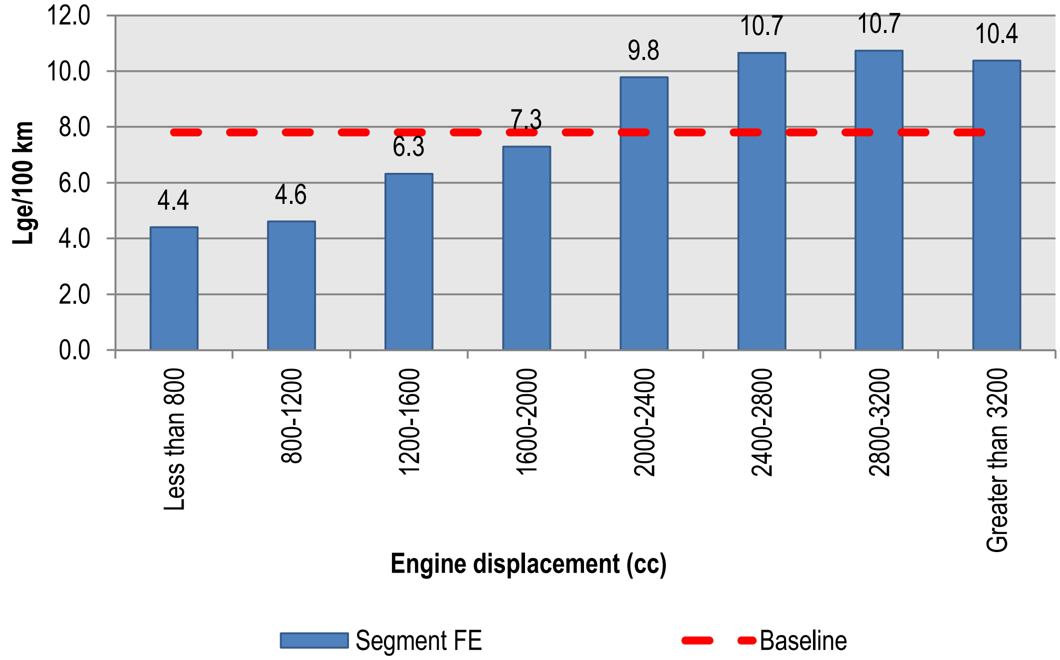
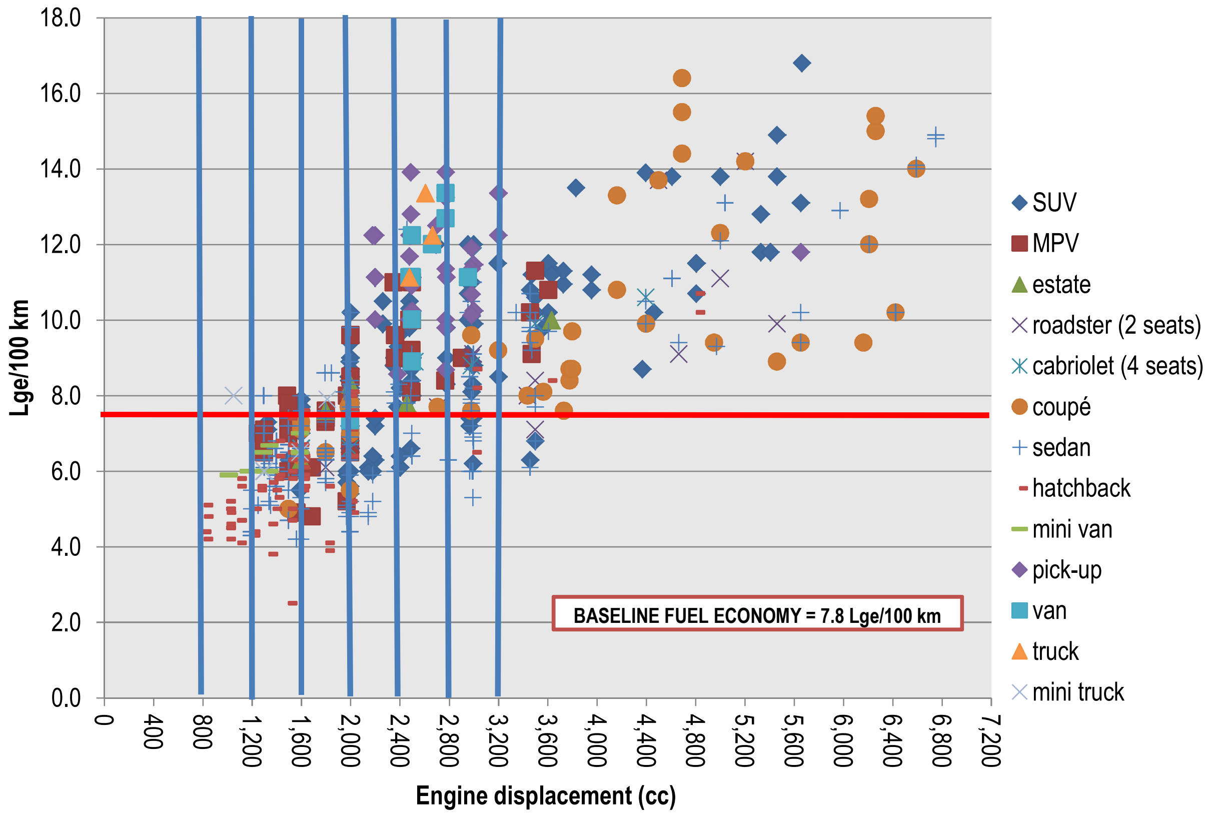


Figure 21 - Scatter plot of fuel economy by engine displacement of LDV body types



Fuel Economy and Segments

a. Fuel Economy by Body Type

Figure 22 - Fuel economy by body type of newly registered LDVs

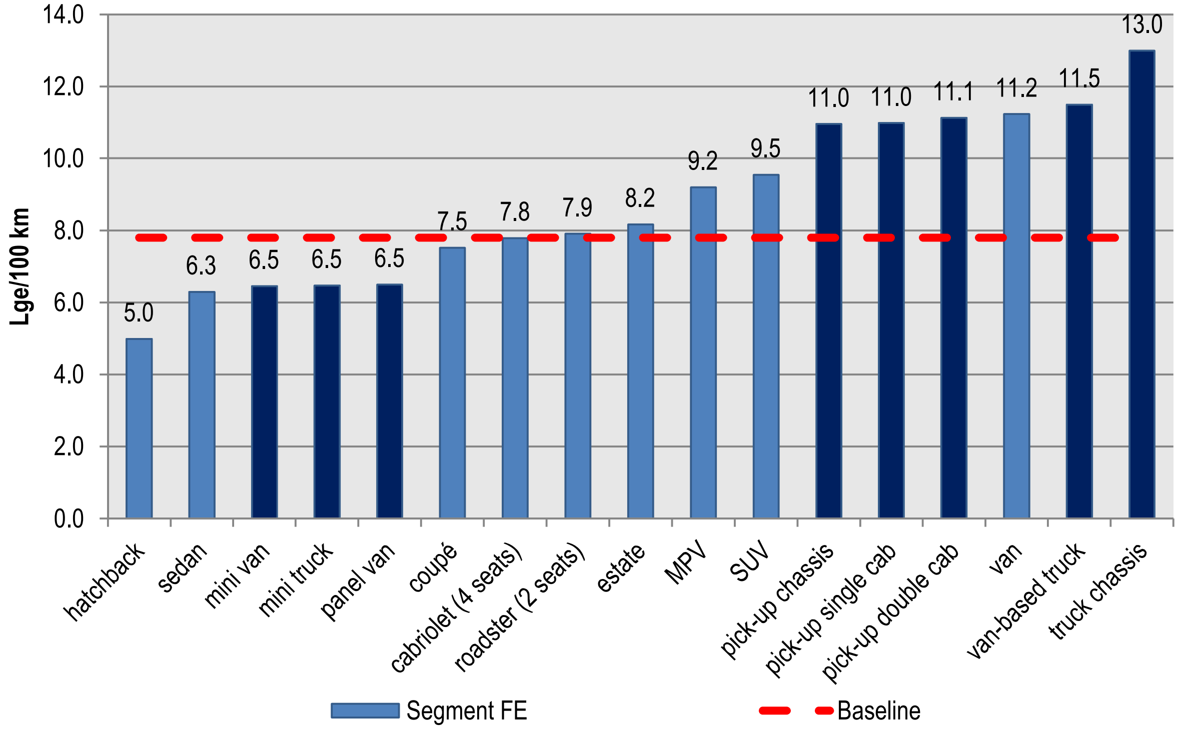


Figure 22 shows a comparison of harmonic mean fuel economy for each body type. The dark blue bars are the LCVs and the light blue bars are the passenger cars. It can be seen from this chart that the large body types have fuel economy above the baseline, meaning these body types are less efficient. The hatchback has the most efficiency across all body types, while the truck chassis have the least. As shown in earlier sections, the truck chassis has one of the heaviest vehicle bodies and one of the highest engine displacement.

b. Fuel Economy and Gearing

Figure 23 and Figure 24 provide additional insights into the rated fuel economy of vehicle segments by gearing and transmission. It can be seen that when compared to baseline, the registered vehicles with Continuously Variable Transmission (CVT) technology on average is the most fuel efficient compared to baseline, and the others are close to baseline. CVT, also known as single-speed transmission, gearless transmission, one-speed automatic and variable pulley transmission, is a transmission technology that can change seamlessly through an infinite number of effective gear ratios to find the perfect combination for speed, fuel efficiency, or both (Haj-Assaad, 2012). This result does not immediately imply that CVT is better than the other transmission types, although further investigation is recommended.

Figure 23 - Fuel economy by gearing type

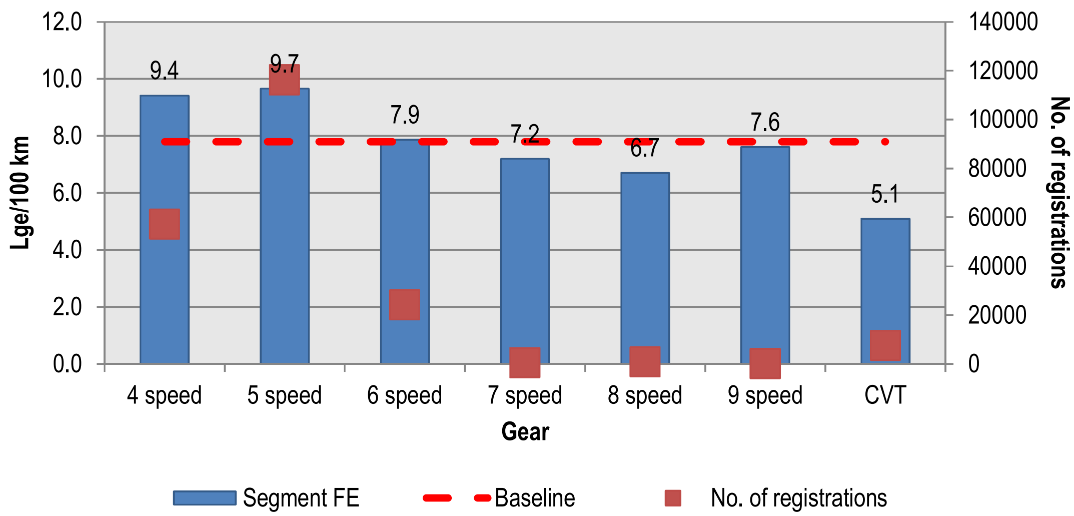
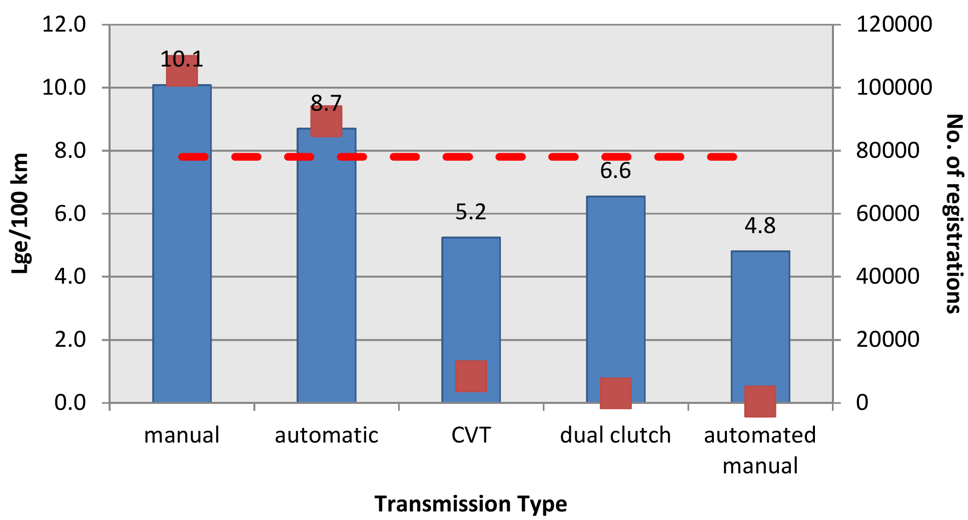


Figure 24 - Fuel economy by transmission type



V. Summary and Conclusion

Based on the available data, the harmonic mean fuel economy of newly registered LDVs in the Philippines during 2013 is 7.8 Lge/100 km. Passenger cars perform better than baseline at 7.3 Lge/100 km while LCVs perform worse than baseline at 9.9 Lge/100 km.

It can be inferred that sedans and SUVs determined the fleet-wide fuel economy of passenger cars newly registered in 2013. Light sedans in particular are in-demand vehicles in the Philippines due to their relatively cheap costs, easy access to bank support and market availability. Sedans are about 32% of new registrations and were the bulk of the market at that year. Sedans perform below the baseline at 6.3

Lge/100 km, and seem to be the most fuel efficient passenger cars. The compact size of the sedan makes it easy to maneuver especially in crammed streets of the Philippines' urban areas.

On the other hand, SUVs showed to be less efficient than the baseline. The average fuel economy of SUVs in 2013 was 9.5 Lge/100 km. This is probably because this body type is heavier, larger and has larger engine displacement, although as emphasized, the relationship is merely indicative and further studies must be conducted. SUVs weigh from 1420 to 3502 kg and have a displacement ranging from 1328 to 5663 cc. However, SUVs have more rider capacity than sedans, making them ideal for family driving.

Among LCVs, the market was dominated by vans and pick-ups, and there is a lack of information on what these vehicles were used to understand the demand. It is possible that these vehicles were either adopted for public utility or as freight. The LCVs in the data are heavy vehicles with high engine displacement that indicate inefficiency.

The market preference determines how fuel efficient the fleet is. The private sector plays the role of making energy efficient technology available in the market and the government must ensure that this is met through policy intervention. The fuel economy baseline in this study could serve as a start.

This study does not determine which vehicles are better or not. Rather, it provides estimate of the baseline of the fuel economy based from available data, then compares the fuel economy of the various segments with respect to the data. It also provides a lead on which vehicles may be improved or further tested based on its utilization on the ground.

VI. Recommendations

The baseline serves is just a characterization of the fleet. The results of this study can be used to continue the stakeholder discussions on vehicle fuel economy in the Philippines, especially among the government and private sector representatives of the TWG. It can also be used to support other policy instruments under discussion such as the Philippine Energy Efficiency Roadmap (and action plan), draft Senate bill on National Energy Efficiency and Conservation, and initial discussions to develop a policy for mandatory fuel economy labeling.

The constraints to vehicle data needs to be addressed. The study team employed multiple approaches to acquire data since this is not readily available from government agencies. A deeper involvement and engagement of the private sector to provide data sets (standardized based on the GFEI methodology) is ideal to verify and improve the baseline estimates, as well as to monitor future vehicle growth.

We further recommend for the government to continuously gather annual vehicle registration data to determine the trend of fuel economy across the fleet over the years and to expand the baseline-setting study to include other vehicle types such as Heavy-Duty Vehicles (HDVs) and motorcycles. This will aid government min setting the fuel economy targets for a range of vehicle segments in the long term so that is consistent with the trajectory of vehicle growth that can easily be supported by the private sector and accepted by the public. Fuel economy policies (and the GFEI targets) can only be achieved in the Philippines if there is a clear understanding between policy makers and the automotive industry especially with regards timeline of implementation.

Annex 1: Field Definitions for Segment Y Data

Field	Definition
Serial No.	Identification from Segment Y
Data type	
Country	The country where the data was acquired
Vehicle type	The vehicle classification of the model
Segment-global	The market segment
Data source	The data provider
Production year	Year when model is available in the market
Make	The vehicle's brand or creator
Model	The specific name of the vehicle model
Version	The specific version of the vehicle model
Model code	Specific model code
Body style	The base style of the vehicle model based from global classifications
Transmission type	The power transmission technology of the vehicle
Gears	The gearing technology of the vehicle
Number of Cylinders	The number of cylinders in the engine
Engine Displacement (cc)	The volume within the cylinders of the engine of the vehicle
Fuel type	The required fuel of the vehicle (diesel, petrol, hybrid, electric)
Urban (L/100 km)	Fuel economy of the vehicle when driving in urban areas
Extra Urban (L/100 km)	Fuel economy of the vehicle when driving in extra urban areas (Highways, etc.)
Combined (L/100 km)	The weighted average fuel economy based on the urban and extra urban fuel economy
Norm	The country whose manufacturing specifications were followed
Gross Vehicle Weight (GVW)	The rated maximum vehicle weight of the model

Annex 2: Segment Y Vehicle Segment Definitions

Passenger Cars

Segment	Description
mini	small cars below 3.8m, engines 0.8-1.2 litre, includes slightly larger, cheaper Chinese origin cars
small	sedans and hatchbacks, engines between 1.2 and 1.6, length around 3.8-4.2m
lower medium	sedans and hatchbacks, engines generally between 1.5 and 2.0 litres, length around 4.4m
medium	sedans and hatchbacks, engines generally between 1.8 and 2.4 litres, length around 4.6m
upper medium	mostly sedans, engines around 2 litre, premium brands
large	mostly sedans, length 4.7m+, engines 2 litres and above
luxury	mostly sedans, length 5.0m+, engines 3 litres and above
small MPV	small MPVs, 5-7 seaters, 1.2-1.5 litre engines
medium MPV	MPVs with 5-8 seats, engines 1.8 to 2.5, includes Asian MPVs like Innova
large MPV	MPV with 7 seats or more, engines 2 litre and above
small SUV	SUV body, length below 4.2m, engines up to 1.6 litres
monocoque SUV	monocoque MPVs, engines around 2.0-2.5 litre, seating usually just 5
medium SUV	mostly ladder chassis SUVs, engines 2.0-3.5 litre, length 4.6m+
premium SUV	large or expensive SUVs, engine usually 3.0 litre+
entry sports	small coupe's, cabrio's, engine up to 2 litres, non-premium brands
sports	coupe's, cabrio's, engine above 2 litres, includes non-premium brands
exotic sports	coupe's, cabrio's, engine above 3 litres, premium brands

Light Commercial Vehicles

Segment	Description
mini van	small vans derived from Japanese K-car class, engines up to 1.3 litre
mini truck	small trucks derived from Japanese K-car class, engines up to 1.3 litre
pick-up	pick-up body with single or double cab, engine 2-3 litre
van	panel van, engine above 1.6 litre
truck	cab-over-wheel body, separate load area

Annex 3: LTO Classification of Motor Vehicles

From the LTO-MIS Guidelines for Motor Vehicle Registration

Private and Government

A. Passenger Cars
    - L refers to passenger cars whose gross vehicle weight (GVW) is up to 1600 kgs.
    - M refer to passenger cars whose GVW is 1601-2300 kgs.
    - H refers to passenger cars whose GVW is more than 2300 kgs.

B. UV refers to utility vehicles whose GVW shall not exceed 4,500 kilograms and the passenger capacity thereof is less than eighteen (18).

    TYPES OF UTILITY VEHICLES

    a. Local Pick-ups (UV) – locally manufactured utility vehicles with cut-and-weld type of body, backyard assembled or rebuilt (with or without crew cab) such as Ford Fiera, Owner-Type Jeep, Anfra, Sarao Type Jeepney, Toyota Tamaraw AUV, Mitsubishi AUV, Pinoy and other vehicles with similar design or configuration.
    b. Imported Pick-ups (UV)- an imported {Completely Built Unit (CBU); Semi-Knocked down (SKD); Completely-Knocked-Down (CKD)} light automobile vehicle with or without crew cab/double cab used to carry passengers and /or transport goods. Imported pick-ups include, but are not limited to Mitsubishi "Strada Pick-up, Toyota Hi-lux, Mazda Pick-up, Isuzu Pick-up, Kia Ceres Pick-up, Dodge Ram Pick-up, Pathfinder, and the like.
    c. Imported Passenger Van/Wagon (UV) – an imported {Completely Built Unit (CBU); Semi-Knocked down (SKD); Completely-Knocked-Down (CKD)} commuter vehicle having rear or side doors and side panel designed for transporting people, and is not used to carry cargo. Passenger van/wagon includes, but is not limited to the following: Toyota Lite Ace, Toyota Hi-Ace, Toyota Revo, Mitsubishi L300, Mazda E200, Kia Besta, Pregio, Nissan Adventure, Kia Advantage, Isuzu Highlander, and the like.

C. SPORTS UTILITY VEHICLE (SUV) shall include but not limited to any imported Completely Built Unit (CBU); Semi-Knocked down (SKD); Completely-Knocked-Down (CKD) unit, Model 1991 or later with imported machine-cast body shell specially designed to transport persons and not used primarily for the carriage of freight, merchandise or cargo, and having the characteristics, features, and amenities similar to a car or automobile such as the following:
    a. Mitsubishi Pajero/Montero;
    b. Nissan Patrol/Nissan Terrano;
    c. Toyota Land Cruiser;
    d. Toyota Rav-4;
    e. Ranger Rover;
    f. Land Rover;
    g. Ford Expedition;
    h. Jeep Cherokee;
    i. Daihatsu Feroza
    j. Suzuki Vitara;
    k. Honda CRV
    l. Mercedez Benz Muzzo;
    m. Kia Sportage
    n. Opel Vectra and the like

    Provided that, all 1990 Models and earlier shall be taken as ordinary UV.

Works Cited

Fulton, L. (2014). *Fuel Economy State of the World 2014: The World is Shifting into Gear on Fuel Economy.* Sri Lanka: BAQ 2014.

GFEI. (n.d.). *GFEI Toolkit*. Retrieved December 2014, from Global Fuel Economy Initiative: http://www.unep.org/transport/gfei/autotool/nextsteps/developing_a_baseline.asp

Haj-Assaad, S. (2012, May 30). *Should you buy a car with CVT Transmission?* Retrieved January 27, 2015, from AutoGuide: http://www.autoguide.com/auto-news/2012/05/should-you-buy-a-car-with-a-cvt-transmission.html

OECD/IEA. (2011). *International comparison of light-duty vehicle fuel economy and related characteristics.* Paris: International Energy Agency Head of Publications Service.

Segment Y. (2015). *About Us*. Retrieved January 28, 2015, from Segment Y Automotive Intelligence: http://www.segmenty.com/aboutus.html#