BASELINE STUDY ON VEHICLE INVENTORY AND FUEL ECONOMY FOR MALAWI (KEY FINDINGS)

TASK TEAM- LEAD INSTITUTION

Ministry of Natural Resources, Energy and Mining

Mount Soche Hotel, Blantyre.

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Outline of the Presentation

- Introduction
- Objectives of the Study
- Scope of work
- Methodology
- Key Findings
- Policy Recommendations

Introduction

- The Global Fuel Economy Initiative (GFEI) was launched in 2009 and it is aimed at reducing local air pollution and Green-House Gas (GHG) emissions through the promotion of cleaner and more fuel efficient vehicles.
- Globally, the motivation for implementing CO_2 (GHG) emissions and fuel efficient vehicles (fuel economy standards) emanates from the threat of climate change and potential oil shortages.
- Due to the rapid growth in vehicle population, controlling the fuel energy demand and greenhouse gas (GHG) emissions has become a global concern.
- Road transport is the main means of transportation in Malawi.
- Almost 90% of Malawi's import and exports are transported by road and 99.9% of internal distribution of goods and services are through road transport.
- Road transport therefore is a significant energy end-use sector and thus a major contributor to the increasing Global Greenhouse Gas (GHG) emissions as well as other air pollutants.
- Fuel consumption by transport is expected to increase rapidly due to urbanization and economic growth resulting in greater demand for mobility.
- For example, Malawi vehicle population is projected to grow more than three times by 2036 from the current 290,000 vehicles to 1,034,000 by 2036 (Atkins, 2017).

Main objective

- The overall aim of the study was to obtain information on average fuel economy of newly registered vehicles.
- The study prepared a **vehicle inventory**, vehicle import trend and established the Malawi's national average fuel economy and CO_2 emissions rate.
- Information on vehicular emission would then be used to prepare policy recommendations to support import of cleaner and more efficient vehicles in Malawi.

Specific Objectives

- The specific objectives of the study were to:
  - Develop an inventory of vehicles in the country during the period between 2006 -2015, and assess the trend in average fuel economy and CO_2 emissions.
  - Establish the average fuel economy and average CO_2 emission.
  - Review existing National regulations and incentives to promote cleaner and fuel efficient vehicles.
  - Conduct Cost Benefit Analysis (CBA) of the various policy interventions.

Scope of Work

- Carry out a detailed inventory of the current vehicle population and emerging trends in Malawi during; 2006, 2008, 2010, 2012, 2014, and 2015 period.
- Access and analyze government laws, regulations and policies and incentives to promote cleaner and fuel efficient vehicles and recommend appropriate interventions.
- Conduct Cost Benefit Analysis (CBA) of the various interventions to promote cleaner fuels and vehicles. The aim was to identify and value the economic, financial and social benefits and costs of identified policy interventions.

Methodology

1. Compilation Vehicle registration Data

- The main sources of data for the study was Directorate of Road Traffic and Safety Services (DRTSS) and Plant Vehicle Hire and Engineering Services (PVHES) Database
  - DRTSS Private vehicles, SC and other NGO vehicles
  - PVHES for Government vehicles.
- Missing on the list are MDF, MP and MPS vehicles.
- Data that was captured was only for vehicles registered (first registration) in 2006 to 2015
- Tedious exercise – challenge: data was not in the required form as per GFEI guide lines. Information captured in both MalTIS and by PVHES was limited.

2. Data Cleaning

Cleaning involved

- Removal from the data set of vehicles not registered within the targeted years;
- Separation of new and used vehicles at time of registration;
- Correction of data entry errors e.g. spelling mistakes; and
- Addition of other relevant fields e.g. vehicle horsepower, transmission type, axle configuration etc., to make it as comparable with the GFEI database as possible

- The cleaning process includes sorting out the raw data to fit the objectives of the exercise and to ensure that we only carried out analysis on relevant entries.

3. Data Structuring

The absolute Minimum required is the following:-

- Vehicle make and model
- Model production year
- Year of first registration, if different from model year
- Fuel type
- Engine size
- Domestically produced or imported
- New or second hand imported
- Rated Fuel Economy per model and test cycle basis. This was done by getting data from country of origin or manufacturer or authorised websites.
- Number per model

4. Calculation of fuel Economy

- Calculation of the baseline fuel economy
- Once fuel economy data is available for at least 85% of the newly registered vehicles, weighted average fuel economy can be calculated using the following equation:

$$FE = \frac{\sum_i^n Reg_i \times FE_i}{\sum_i^n Reg_i}$$

With:

$FE = weighted\ average\ fuel\ economy$

$Reg_i = number\ of\ newly\ registered\ vehicles\ of\ type\ i$

$FE_i = fuel\ economy\ of\ vehicle\ of\ type\ i$

5. CO_2 Calculations

Carbon dioxide (CO2) Emission Computations

The CO2 emission rates are based on the annual weighted average emission per segment for petrol and diesel vehicles and estimated for the years.

$$\sum_{1}^{n} SVSi * Ci \Big/ TSy$$

where;

$SVSi$ = Total Sales (Vehicles Registered by PVHES & DRTSS in a given year

C_1 = Sales for a Particular Vehicle Segmentation and Fuel type

TS_y = CO2 Emission for a Particular Vehicle Segmentation and Fuel type

KEY FINDINGS

1. Clean and Fuel Economy Policies

- Tax differential on vehicles with higher engine capacity than those with lower capacity
- Promotion of importation of fairly used vehicles by providing tax incentive for vehicles of 0-8 years and for goods vehicles of 0-15 years.
- Blending of petrol with Ethanol.
- Diesel fuel standard of 50ppm.

ENGINE CAPACITY	AGE	DUTY RATES		
		Import Duty	Import Excise	Import VAT
1000cc-1499cc	0-8 years	25%	0%	16.5%
	8-12 years	25%	30%	16.5%
	12 years and above	25%	60%	16.5%
c 1500cc-1999cc	0-8 years	25%	15%	16.5%
	8-12 years	25%	45%	16.5%
	12 years and above	25%	75%	16.5%
2000cc-2499cc	0-8 years	25%	35%	16.5%
	8-12 years	25%	60%	16.5%
	12 years and above	25%	90%	16.5%
2500cc-2999cc	0-8 years	25%	45%	16.5%
	8-12 years	25%	70%	16.5%
	12 years and above	25%	100%	16.5%
Exceeding 3000cc	0-8 years	25%	55%	16.5%
	8-12 years	25%	80%	16.5%
	12 years and above	25%	110%	16.5%

Note that the analysis shows that the tax incentives on vehicle options has yielded minimal overall impact.

2. Vehicle Inventory

i. Imported vehicles

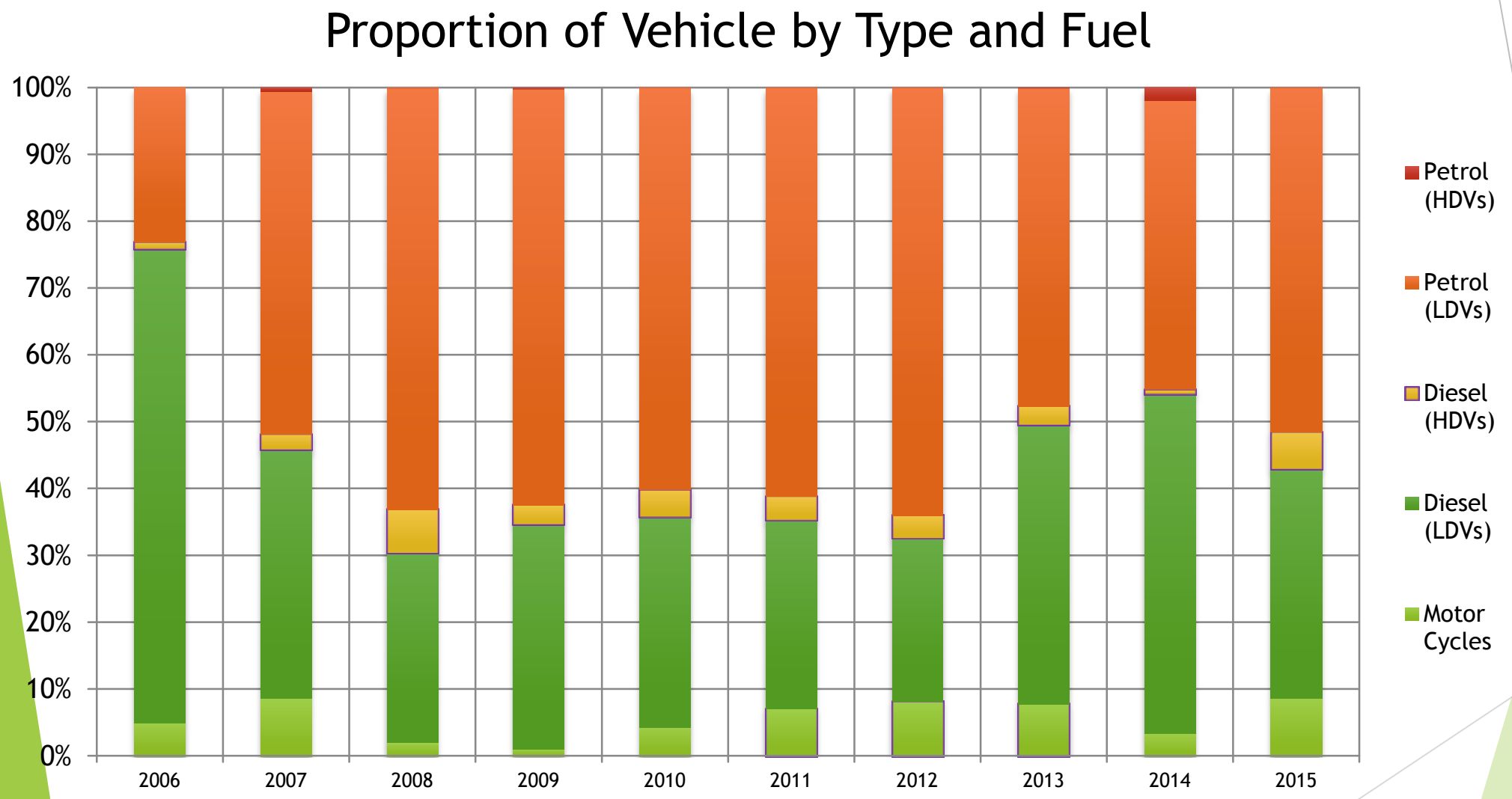
- From 2006 to 2015 Malawi has registered **175,208** vehicles
- Of which **70,031** were diesel vehicles and **95,555** were petrol driven vehicles and about **9,622** were motorcycles.
- About **(15,162) 22%** of registered diesel vehicles were new and only **(3,131) 3.3%** of the registered petrol vehicles were new while **(5,551) 58%** of motorcycles were new.
- This implied that about **75%** of vehicles imported into the were used vehicles i.e. second hand vehicles from countries such as Japan or Europe.
- Details refer to the table below

ii. Vehicle Imports by Engine Capacities

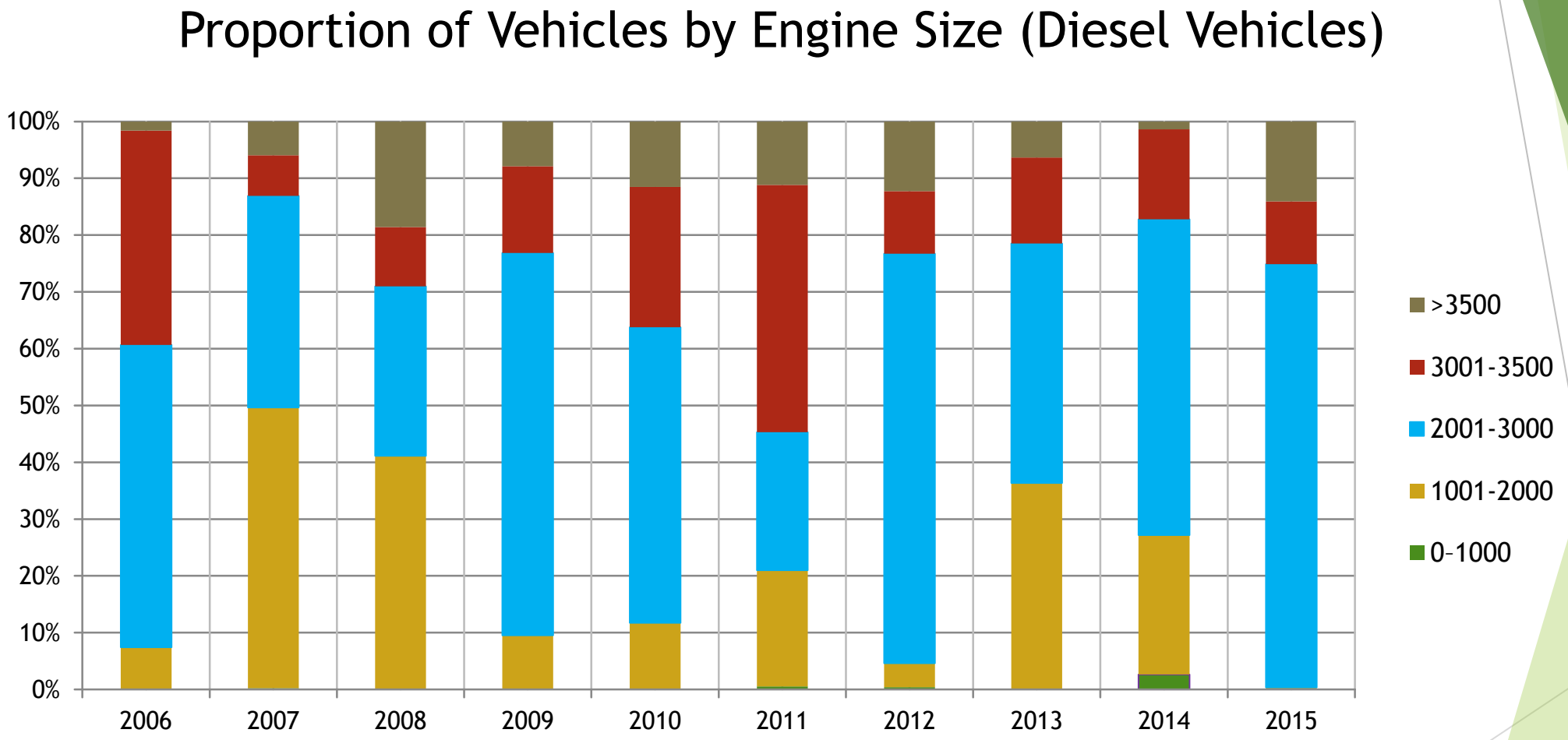
	Engine Capacity	Diesel				Petrol			
		New	Old	Total	New as % of total	New	Old	Total	New as % of total
LDVs	0-1000	9	426	435	2.1	1	498	499	0.2
	1001-2000	3651	11,518	15,169	24.1	1,356	70,645	72,001	1.9
	2001-3000	10284	25,136	35,420	29.0	1,754	4,726	6,480	27.1
	3001-3500	821	12,636	13,457	6.1	5	15,973	15,978	0.0
Sub Total		14,765	49,716	64,481	22.9	3,116	91,842	94.958	3.3
LDVs	>3500	397	5,153	5,550	7.2	15	582	597	2.5
Total		15,162	54,869	70,031	21.7	3,131	92,424	95,555	3.3

Year	Motor Cycles				Motor Vehicles								Total
					Diesel				Petrol				
	New	Second Hand	Total	New as % of Total	New	Second Hand	Total	New as % of Total	New	Second Hand	Total	New as % of Total	
2006	369	14	383	96	2,046	3,403	5,449	38	519	1,229	1,748	29.7	7,580
2007	324	555	879	37	1,267	2,741	4,008	32	51	5,210	5,261	1.0	10,148
2008	262	32	294	89	1,326	3,688	5,014	26	133	8,934	9,067	1.5	14,375
2009	137	76	213	64	1,968	5,066	7,034	28	53	1,997	12,050	0.4	19,297
2010	836	51	887	94	1,635	5,587	7,222	23	45	12,182	12,227	0.4	20,336
2011	320	1,082	1,402	23	1,124	5,174	6,298	18	707	11,404	12,111	5.8	19,811
2012	1,189	555	1,769	67	1,537	4,469	6,006	26	48	13,785	13,833	0.3	21,608
2013	1,363	772	2,135	64	2,308	9,875	12,183	19	53	12,966	13,019	0.4	27,337
2014	379	489	868	44	1,317	11,891	13,208	10	1,413	10,152	11,565	12.2	25,641
2015	372	420	792	47	634	2,975	3,609	18	109	4,565	4,674	2.3	9,075
Total	**5,551**	**4,046**	**9,622**	**57.7**	**15,162**	**54,869**	**70,031**	**21.7**	**3,131**	**92,424**	**95,555**	**3.3%**	**175,208**

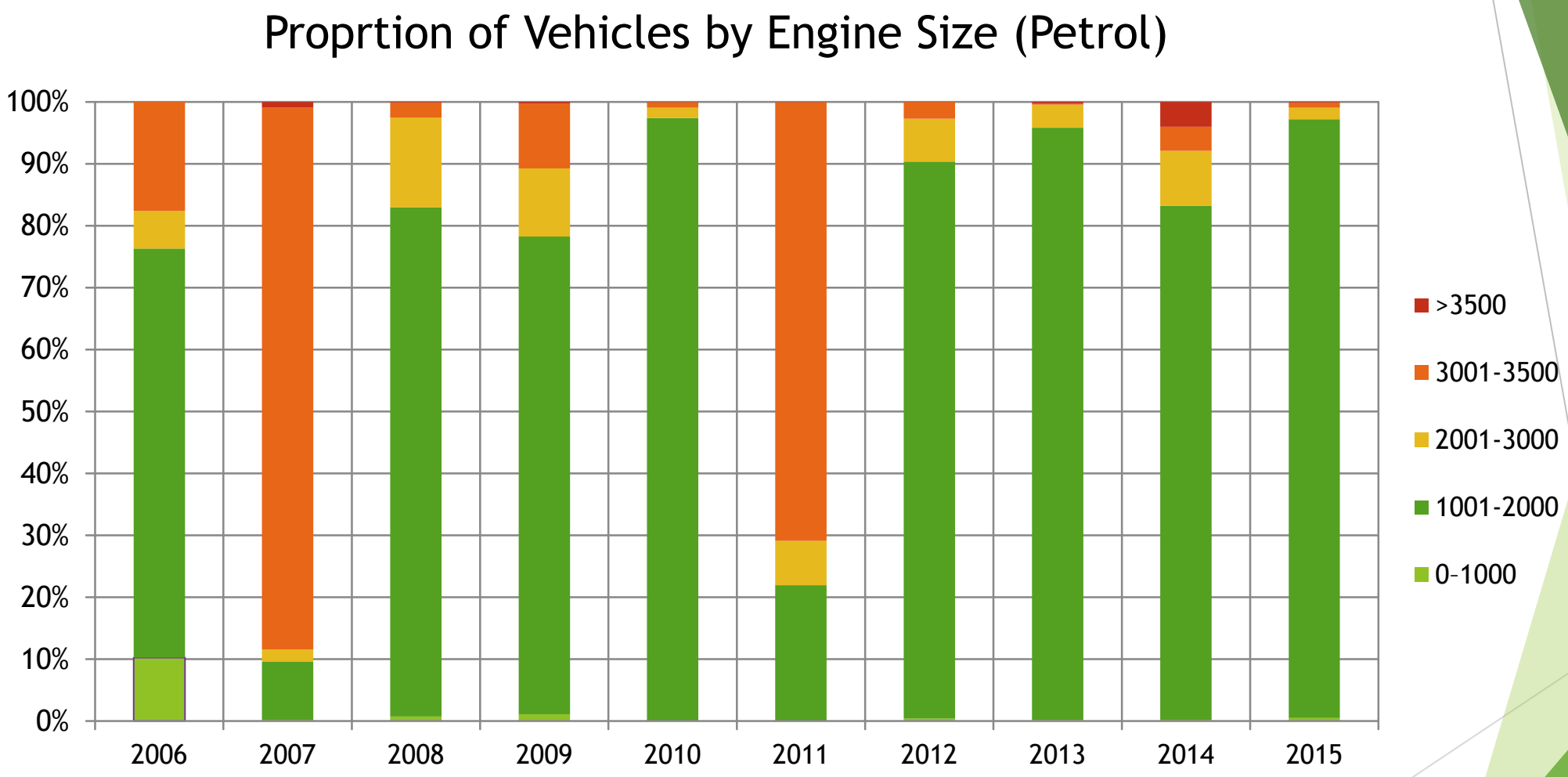
iii. Vehicles registered by Type and Fuel



iv. Engine Capacities of Registered vehicles



iv. Engine Capacities of Registered vehicles



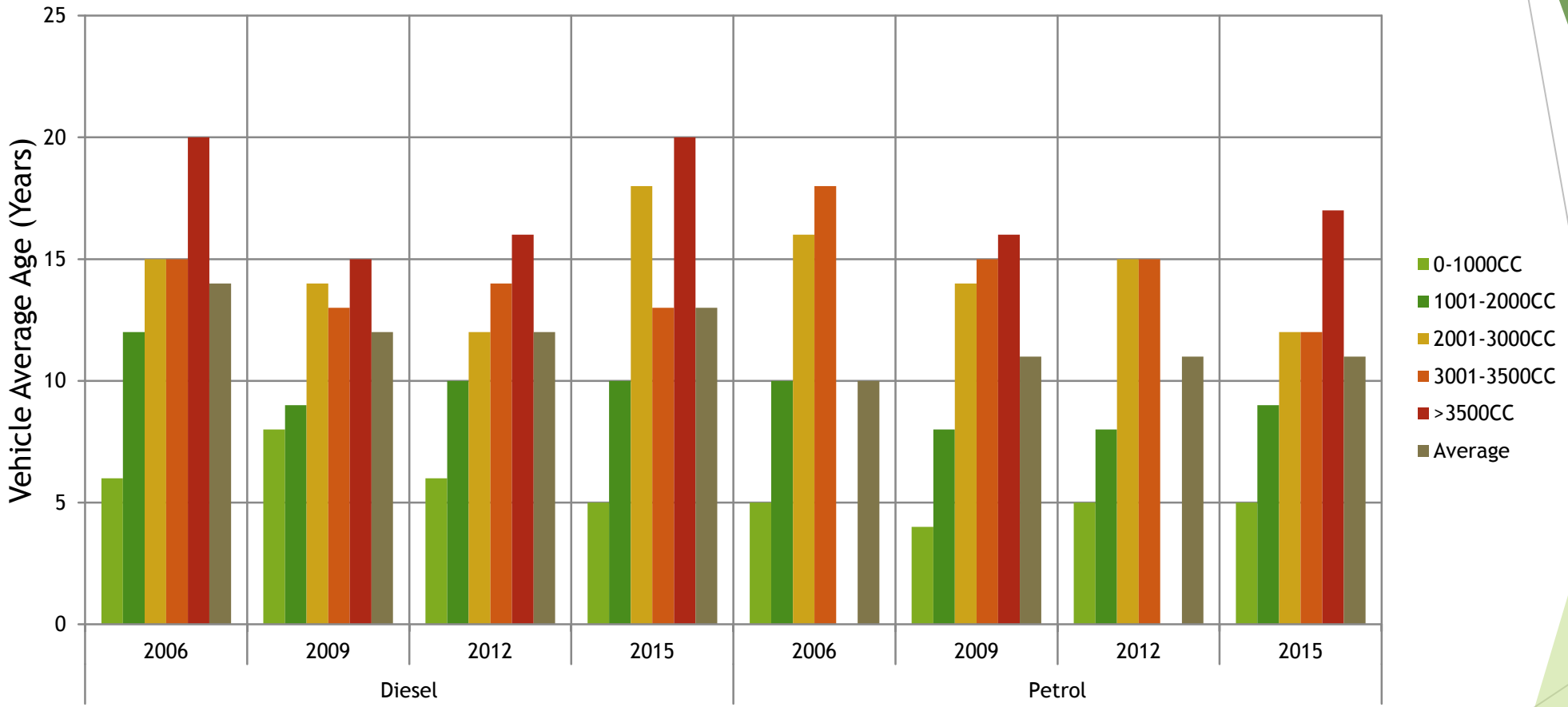
iv. Engine Capacities of Registered vehicles

- The larger quantity of vehicles for both diesel and petrol were of the rage 1001CC-3500 CC
- 75% petrol driven vehicles were registered for the CC range 1001-2000cc this can be attributed to the tax incentive (reduced import excise) that is offered to vehicle with lower CC
- 50% of diesel vehicles were of range 2001-3000CC
- Few petrol vehicle were registered above 3001CC as compared to diesel vehicles.
- Diesel vehicles had bigger engine sizes than the petrol driven vehicles in the period under review.

v. Average Age of the vehicles

Engine Capacity (CC)	Diesel				Petrol			
	2006	2009	2012	2015	2006	2009	2012	2015
0-1000	6	8	6	5	5	4	5	5
1001-2000	12	9	10	10	10	8	8	9
2001-3000	15	14	12	18	16	14	15	12
3001-3500	15	13	14	13	18	15	15	12
>3500	20	15	16	20	-	16		17
Average Age	14	12	12	13	10	11	11	11

v. Average Age of Diesel and Petrol Vehicles



As seen the country has an aging population of vehicles.

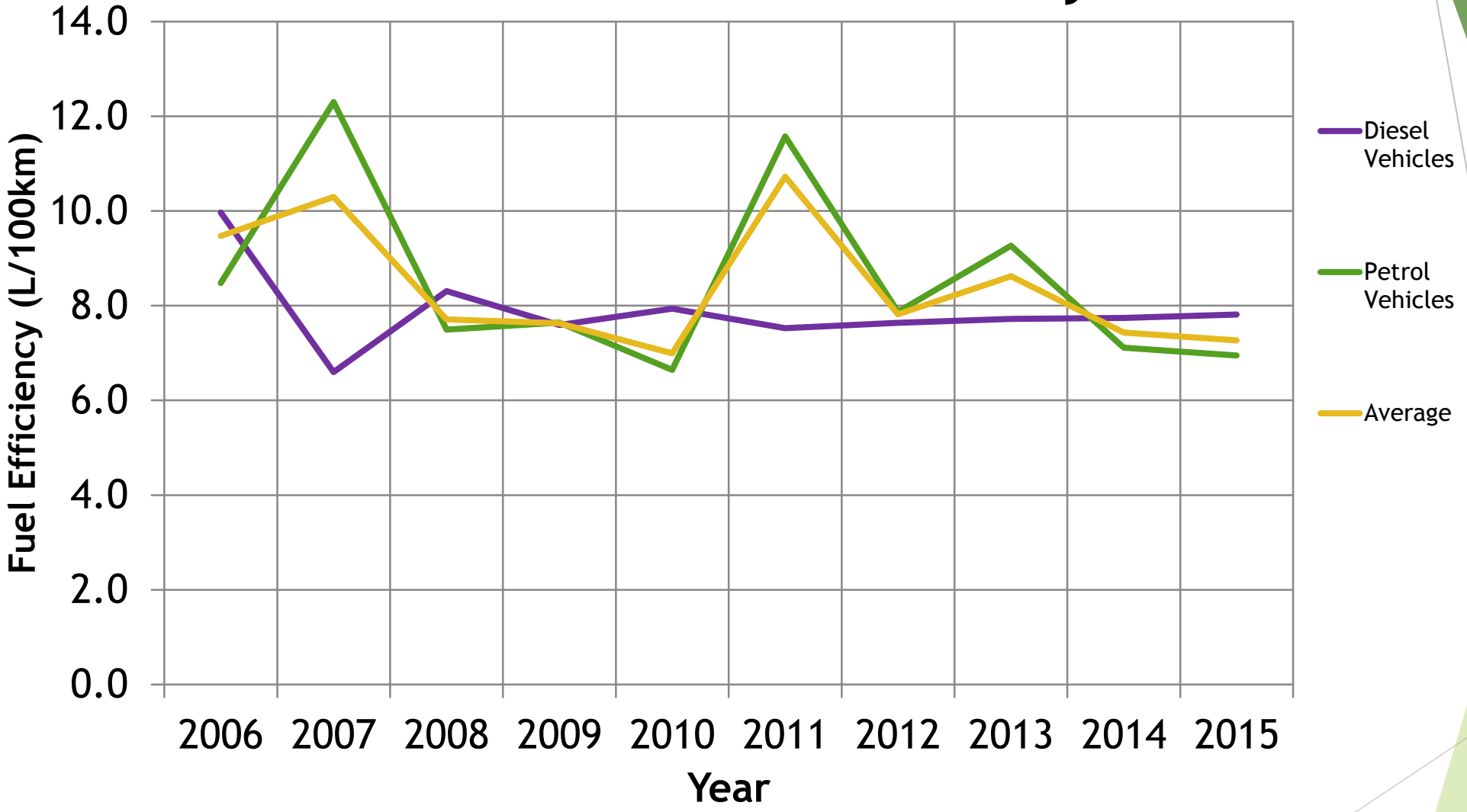
3. VEHICLE FUEL ECONOMY AND CO_2 EMISSIONS

- Fuel economy and CO_2 emission were based on the GFEI methodology.
- Because of lack of data for 2005, 2006 was used as the baseline.
- Fuel efficiency rates expressed in terms of liters of petrol/ diesel per 100 kilometers of travel (L/100 Km)
- CO2 emission rates in grams per kilometer (gCO_2/Km) for vehicles registered from 2006 to 2015
- Calculations for fuel economy were based on published data from manufacturers, Dealers and Distributors and GFEI recommended websites
- The engine capacity were categorized into 5 sub-groups (0 – 1000cc, 1001 -2000cc, 2001 – 3000cc and 3001 – 3500cc
- Motorcycles and vehicles with the engine capacity of more than 3500CC were excluded.
- Vehicles with engine capacity in each range are assumed to exhibit similar fuel efficiency and CO_2 emission rates

i. Annual Vehicle Efficiency and CO2 Emissions

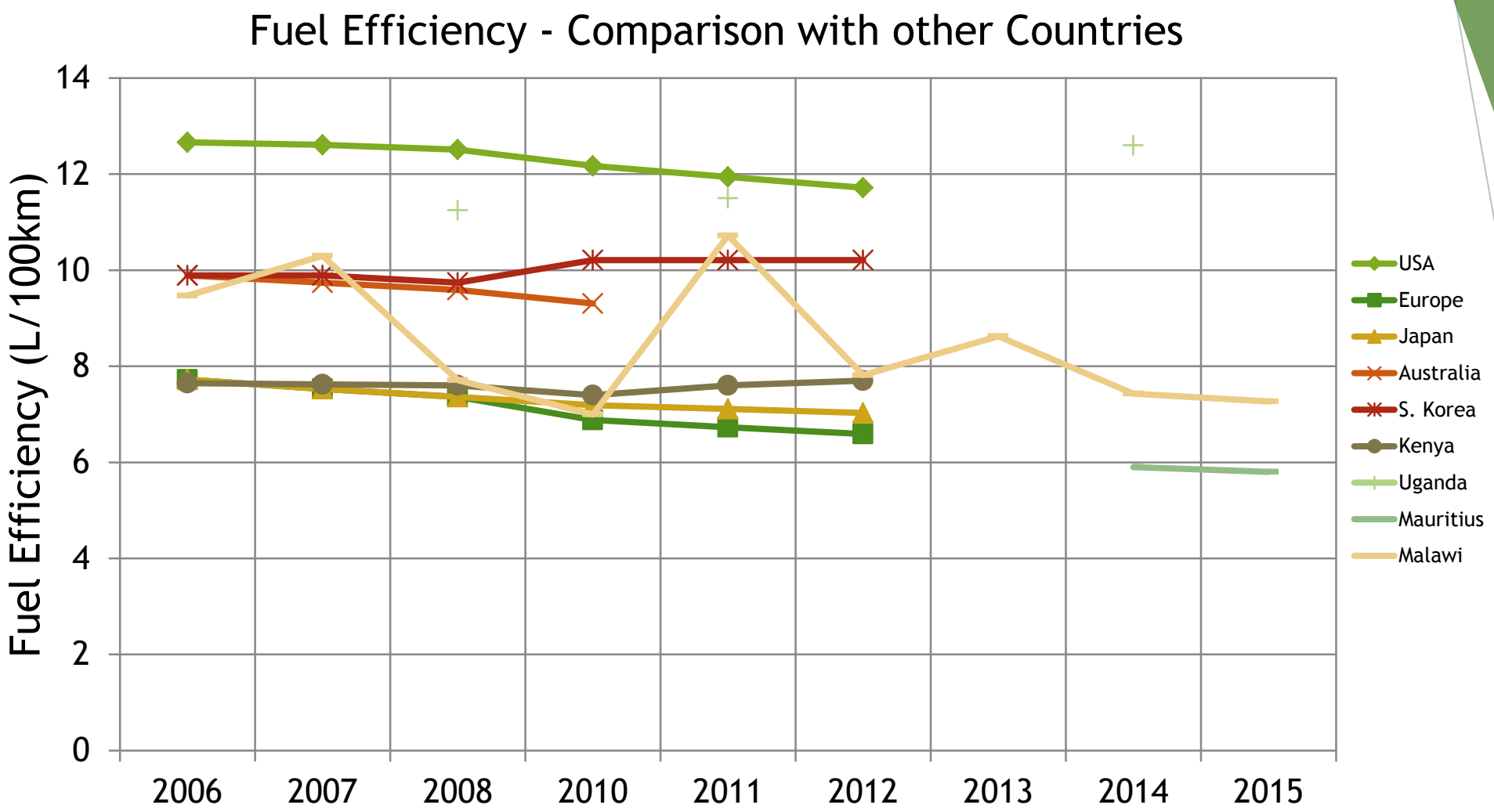
Year	Diesel Vehicles		Petrol Vehicles		Average	
	Fuel Efficiency (L/100km)	CO_2 Emissions (g/km)	Fuel Efficiency (L/100km)	CO_2 Emissions (g/km)	Fuel Efficiency (L100km)	CO_2 Emissions (g/km)
2006	10.0	264.5	8.5	197.4	9.5	242.2
2007	6.6	178.6	12.3	323.9	10.3	271.8
2008	8.3	218.4	7.5	179.5	7.7	190.0
2009	7.6	200.3	7.6	182.2	7.6	187.7
2010	7.9	209.1	6.6	158.2	7.0	172.2
2011	7.5	195.6	11.6	278.1	10.7	260.8
2012	7.6	202.1	7.9	185.5	7.8	189.4
2013	7.7	202.3	9.3	219.9	8.6	212.5
2014	7.7	200.6	7.1	165.2	7.4	183.2
2015	7.8	205.9	6.9	164.8	7.3	180.0
Avge	8.2	216.1	8.3	196.7	8.3	203.9

ii. Vehicle Fuel Efficiency



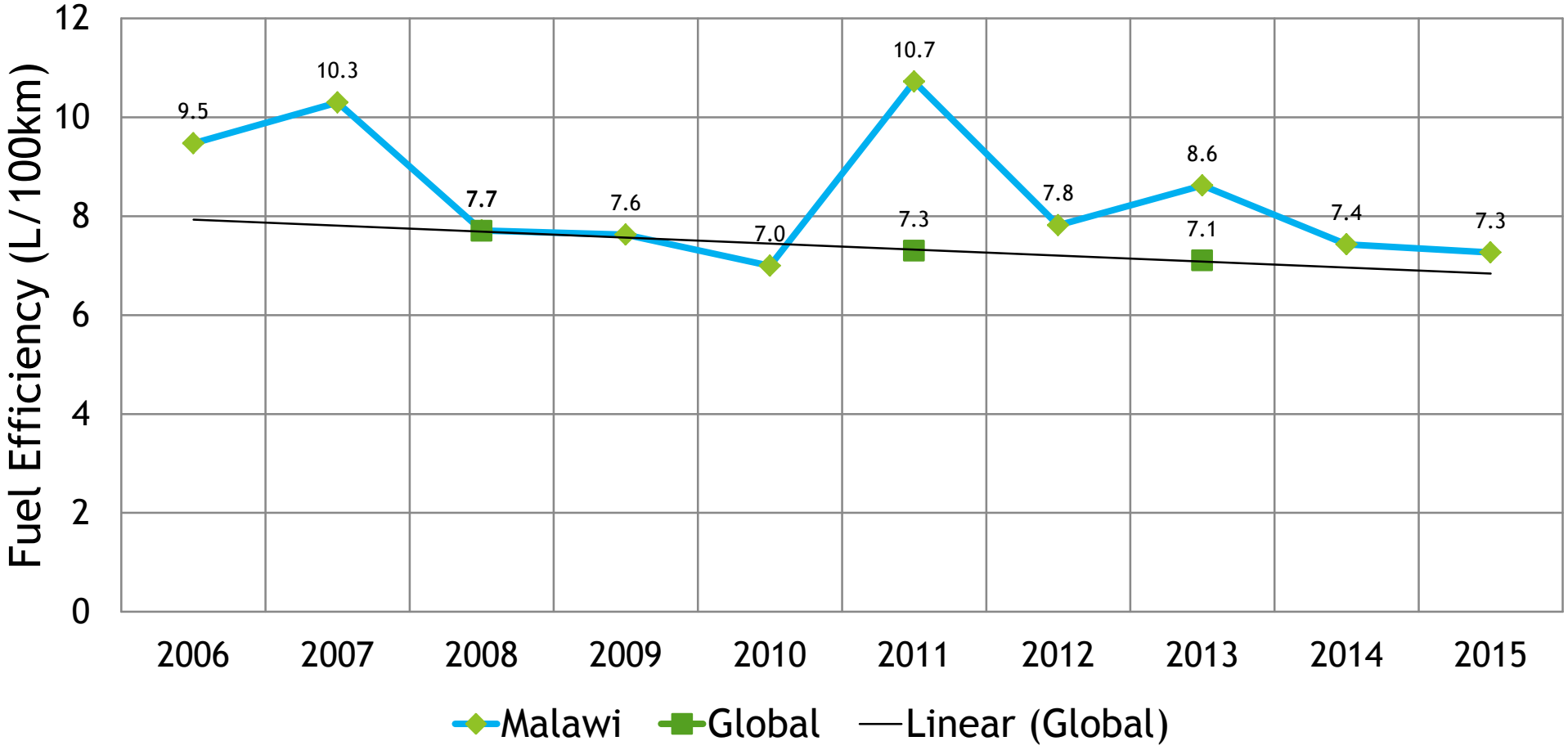
iii. Comparison of Fuel Efficiency with other countries

Year	USA	Europe	Japan	Australia	S. Korea	Kenya	Uganda	Mauritius	Malawi
2006	12.66	7.72	7.72	9.89	9.89	7.65			9.5
2007	12.61	7.53	7.53	9.74	9.89	7.62			10.3
2008	12.51	7.36	7.36	9.59	9.74	7.60	11.25		7.7
2010	12.17	6.88	7.19	9.31	10.21	7.40			7.0
2011	11.94	6.73	7.11		10.21	7.60	11.50		10.7
2012	11.72	6.59	7.03		10.21	7.70			7.8
2013									8.6
2014							12.6	5.9	7.4
2015								5.8	7.3



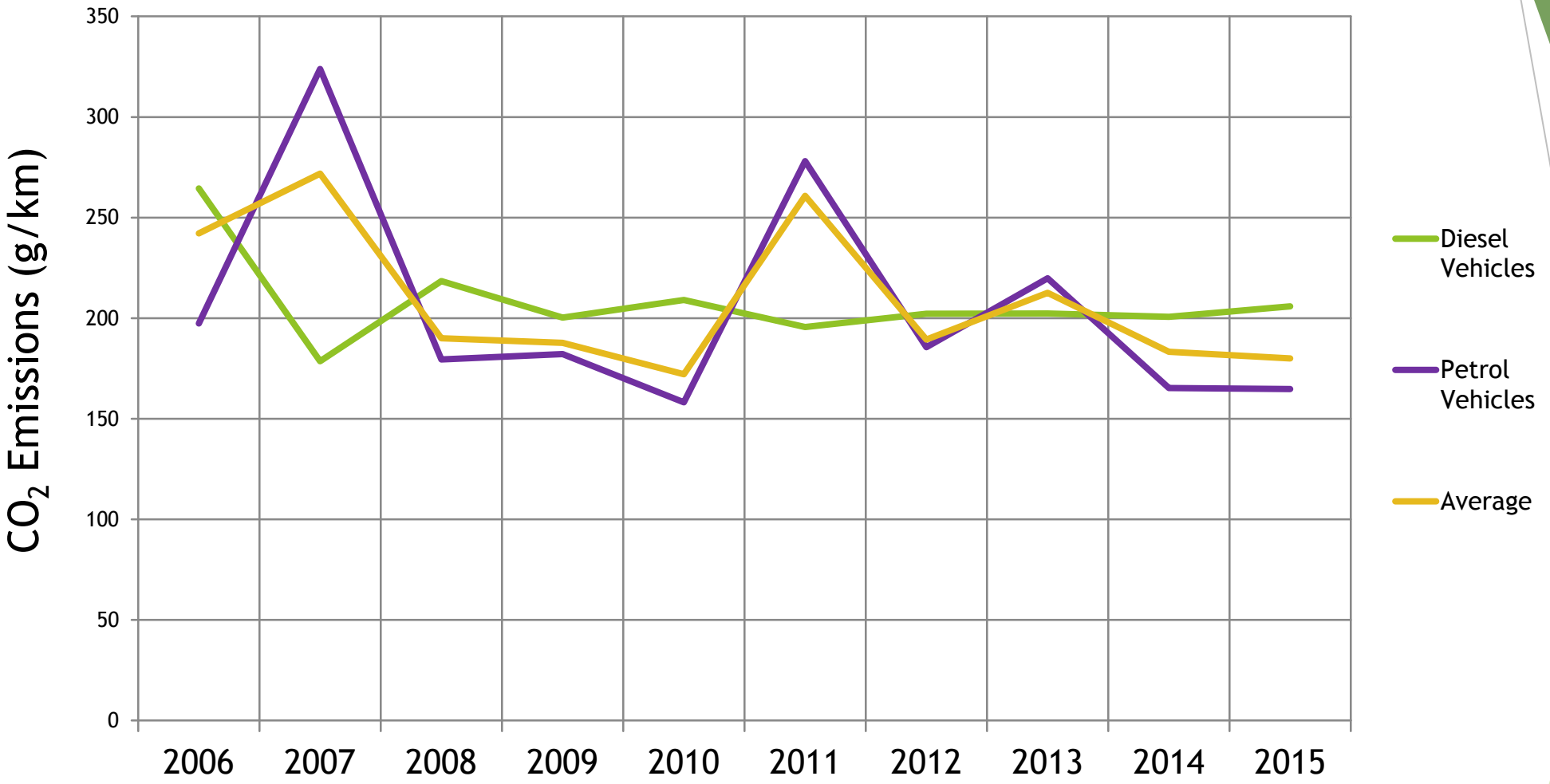
- The fleet of vehicles in the country has higher fuel efficiency as compared to countries such as Uganda, USA and Australia.
- However, the fleet of vehicles has lower fuel efficiency as compared to countries such as Mauritius, Europe and Japan.

iv. Comparison of Fuel Efficiency with the Global Average



- In general the average fuel efficiency for the country is lower compared to the global average.
- Malawi does not have any standards on fuel efficiency.

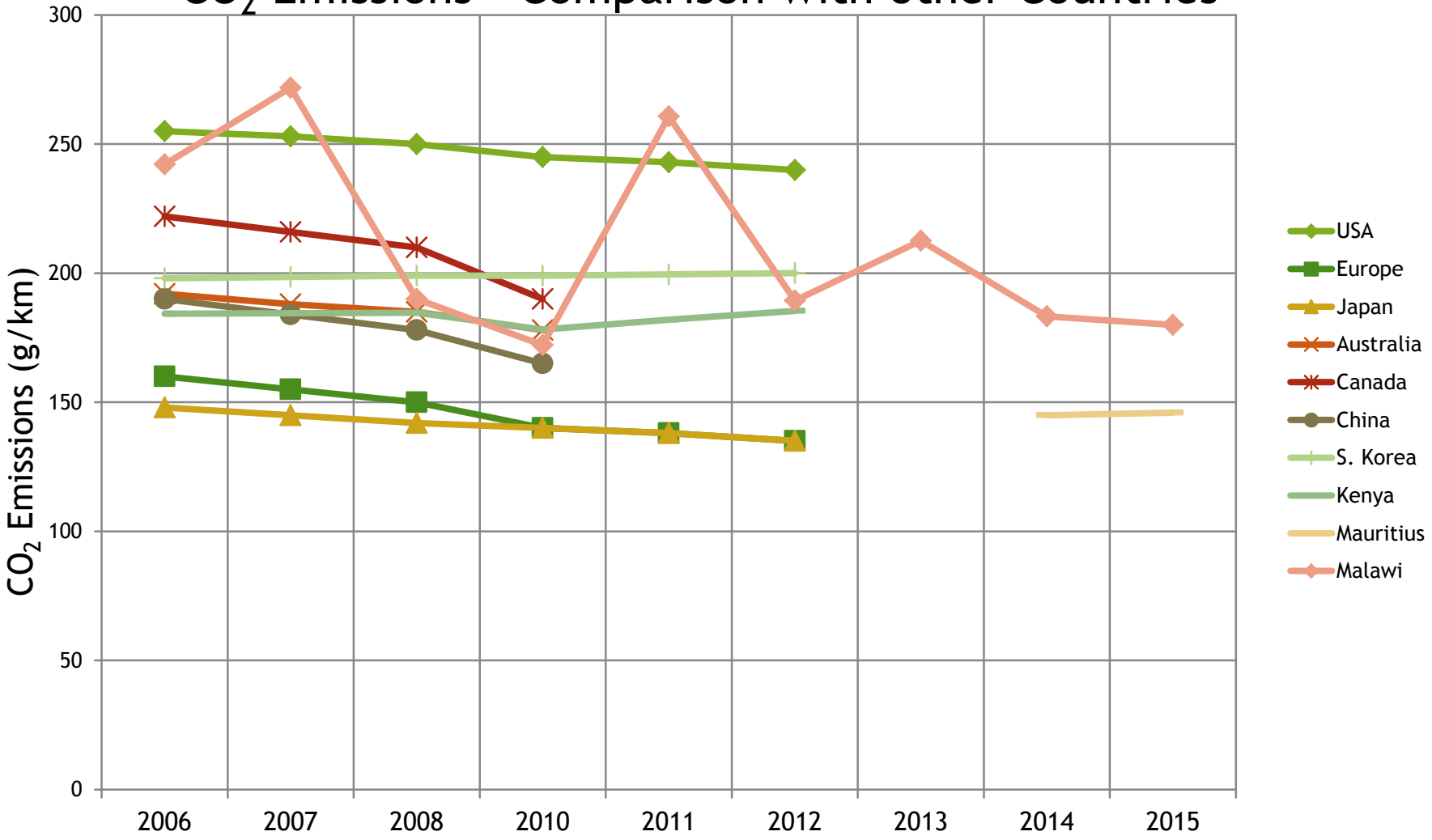
v. Vehicle CO_2 Emissions



vi. CO_2 Emissions – Comparison with other Countries

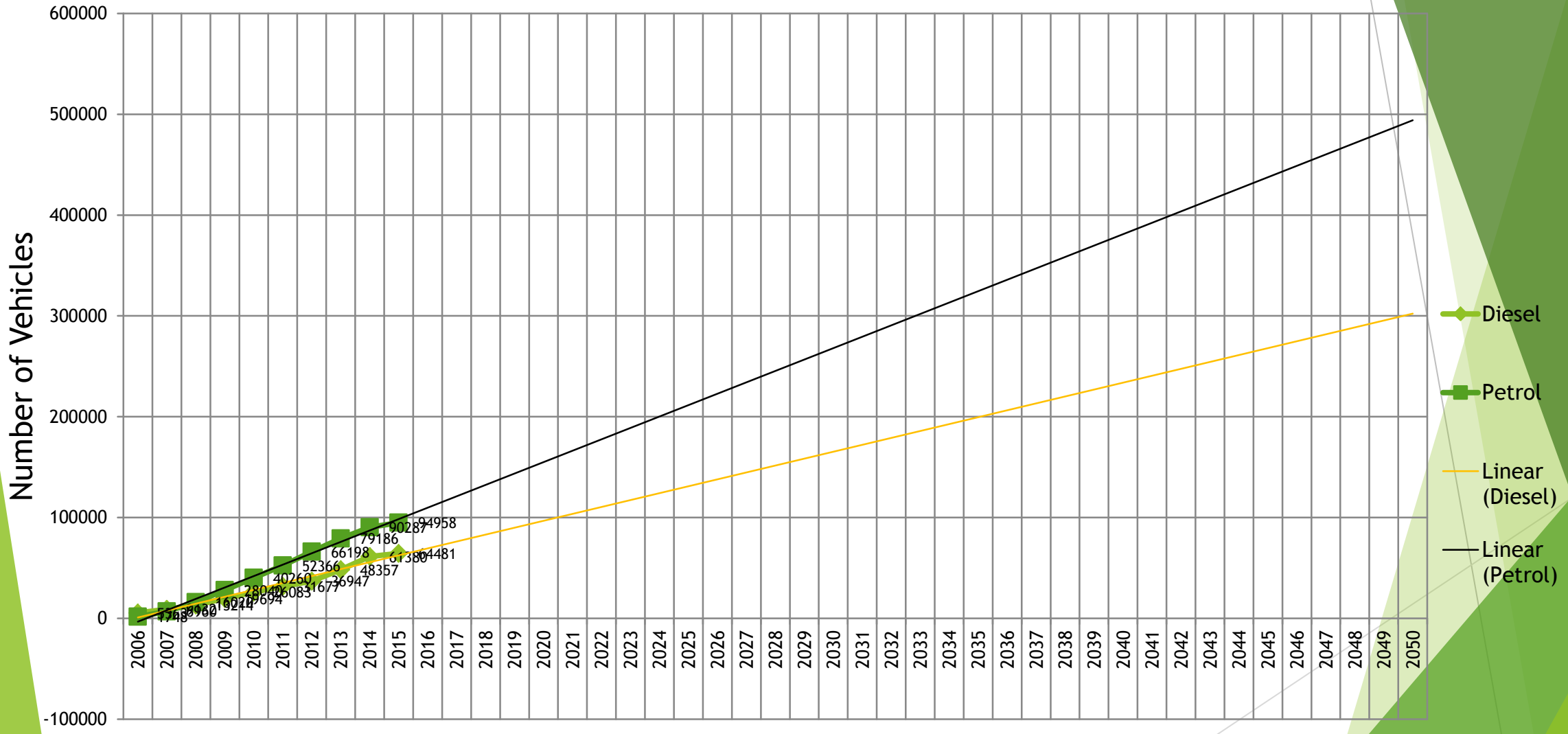
Year	USA	Europe	Japan	Australia	Canada	China	S. Korea	Kenya	Mauritius	Malawi
2006	255	160	148	192	222	190	198	184		242
2007	253	155	145	188	216	184	199	185		272
2008	250	150	142	185	210	178	199	185		190
2010	245	140	140	178	190	165	199	178		172
2011	243	138	138				200	182		261
2012	240	135	135				200	185		189
2013										213
2014									145	183
2015									146	180

CO_2 Emissions - Comparison with other Countries



- In general the average CO_2 emissions for the country are lower compared to countries such as USA.
- However, CO_2 emissions are higher as compared t countries such as Japan, Europe and Mauritius.

4. Forecast of Low Duty Vehicles (LDVs) up to 2050



Forecast of Low Duty Vehicles (LDVs) up to 2050

- The graph shows the forecast of LDVs registered up to the year 2050 based on the current trends.
- Cumulative diesel LDVs registered are expected to increase to 125,000 in 2025 and 300,000 in 2050.
- Cumulative petrol LDVs registered are expected to increase to 215,000 in 2025 and 500,000 in 2050.
- For the same engine size diesel vehicles are more efficient than petrol vehicles. The increase in petrol vehicles would therefore reduce the overall vehicle fuel efficiency.

5. Cost Benefit Analysis (CBA)

This section is about the costs and benefits of reducing CO_2 gas emissions.

Quantifiable financial costs

Policy formulation

- Policy formulation requires wider consultations and related activities. These require financial resources.

Technical capacity building (if necessary)

- This may become necessary if some policies require periodic testing of CO_2 emissions.
- It would require substantial financial investment in capital equipment and human resource training.
- Maintenance costs

5. Cost Benefit Analysis

Costs

Enforcement

- Depending on the policy, some form of enforcement would be required. This requires resource mobilization.

Loss of revenue on fuel levies and taxes.

- Tax on fuel imports
- Levies on fuel

5. Cost Benefit Analysis

Loss of revenue on other fuel related taxes.

- Loss of fuel-related taxes such as corporate tax due to reduced trading.

Civic education and publicity

- Publications
- Information dissemination costs

5. Cost Benefit Analysis

Benefits

The major financial benefit is savings on foreign currency.

Malawi is currently using 11 million litres of fuel and 13 million litres of diesel fuel per month.

For reduction in fuel usage of 5% would result in foreign exchange savings of MK7 billion per year.

The direct net benefit is MK1.3 billion per year for a 5% reduction in fuel usage

5. Cost Benefit Analysis

Costs and Benefits

Activity	Cost per year (MK)	Benefit per year (MK)
Regulatory policy development	20,000,000	
Public awareness campaigns	500,000,000	
Loss of revenue on oil taxes & levies	5,376,000,000	
Savings on forex		7,176,000,000
Job creation		36,000,000
Totals	5,896,000,000	7,212,000,000
Net Benefit		1,316,000,000

5. Cost Benefit Analysis

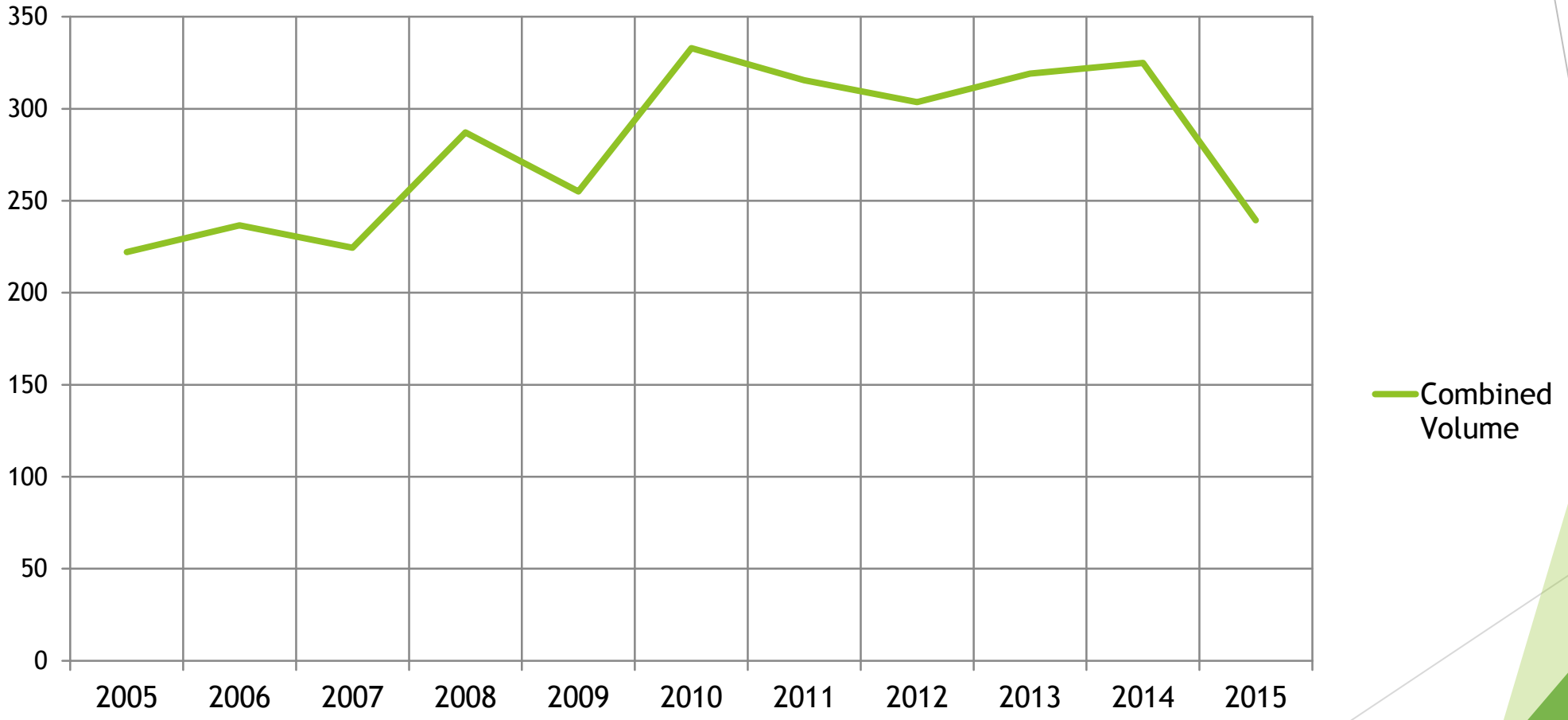
The fuel usage increase rate is not at the same rate as increase rate of vehicle population.

There are two possible reasons for this.

1. The has been an increase in fuel prices. The vehicle owner responds by either reducing on vehicle usage or using a much more vehicle efficient vehicle.
2. Higher tax on vehicles with high capacity engines. Vehicle importers respond by importing small capacity engines.

5. Cost Benefit Analysis

Fuel usage trend (million litres)



THANK YOU

God bless you