GLOBAL FUEL ECONOMY INITIATIVE

Motor Vehicle Inventory

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Outline

- Approach to developing vehicle fuel economy database
- Findings
- Recommendations

Approach

- Based on the two documents in the ToRs:
  - Methodological Guide to Developing Vehicle Fuel Economy Databases Prepared for the Transport Unit Division of Technology, Industry and Economics, UNEP by the Climate XL Africa
  - GFEI Tool User Guide, UNEP

Approach

- Approach was informed by the GFE Guidelines which recommends use a participatory, collaborative and integrated approach.
- Consultant approached CVR, ZIMRA, ZINARA and ZERA to get vehicle registration details
- CVR being the principal custodian of all the vehicle registration details provided the data.

Approach

Step 1:
Set Objectives

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Step 2:
Collect Vehicle Registration Data

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Step 3:
Clean Data

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Step 4:
Structure Data

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Step 5:
Estimate Fuel Economy

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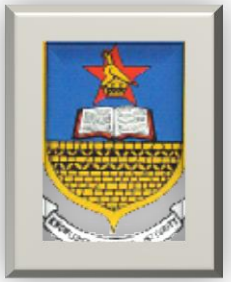
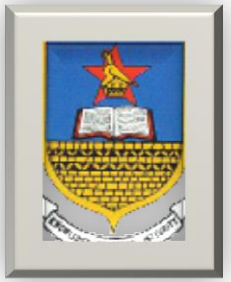
Step 6: Report Findings



Objectives

- Conduct a vehicle inventory of Zimbabwe focusing on: make, model, body type, model year, fuel type, engine size, registration status, tare weight etc of vehicles in Zimbabwe.
  - The inventory focused vehicles imported and manufactured locally in 2005, 2008, 2011, 2013 and 2016

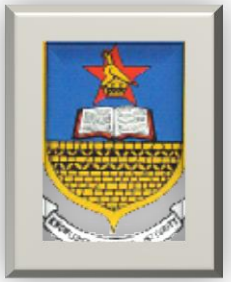


Objectives: Why Inventory?

- Vehicle emissions cause problems with severe health, environmental & economic consequences
- Transportation sector contributes about 26% of global carbon emissions and this is projected to increase to 75% in 2020
- Minimising vehicle emissions will contribute to reduction in atmospheric concentrations of pollutants

Collection of Vehicle Registration Data

- Data from CVR contained 8 variables for each record:
  - Make (Toyota, Mitsubishi, …)
  - Model (Nissan X-trail, Nissan Sunny, …)
  - Type of body/Description (Saloon, S/ Wagon,…)
  - Engine size
  - Year of manufacture
  - Year of first registration by CVR.
  - Fuel type (diesel, petrol, other)
  - Tare weight/Net mass (kilograms)
- Initial dataset had 229 075 vehicles for the years 2005,2008,2011, 2013 and 2016

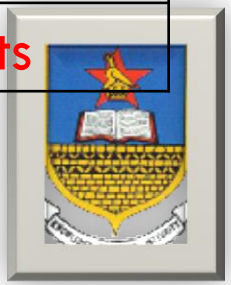


Clean Data

- The data cleaning process entailed:
  - Removing all vehicles with net mass above 2 300 kg.
  - Separation of new and used vehicles.
  - Removing vehicles without/incorrect models and makes
  - Separating motor vehicles and motorcycles.
  - Removing trailers.
  - Rectification of data entry errors
- Cleaned database had 212 180 LDVs.
- Of the 212 180, 9% were new while 91% were used

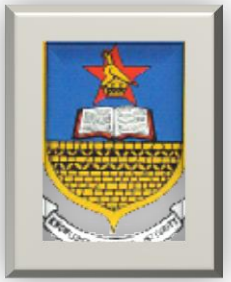
Restructure Data to Conform to GFEI

Vehicle Type	Engine cylinders	Model year
Model	Engine ccm	Number of gears
Manufacturer	CC Category	Transmission type
Body type	Engine kW	Turbo
Simplified Body Type	KW class	Gross vehicle weight (Net Mass)
Segment	Engine horse power	Height
Axle configuration	Engine valves	Length
Driven wheels	Fuel type	Number of seats



Populating Missing Fields of Data

- The major inputs which go into developing a vehicle fuel economy database are:
  - fuel consumption in L/100km and
  - CO_2 emission in g/100km.
- Values for these variables were obtained from websites recommended by GFEI.
  - http://www.epa.gov/fueleconomy/gas-label-1.htm;
  - http://www.carfolio.com/



Findings

Population Trends of Registered Vehicles

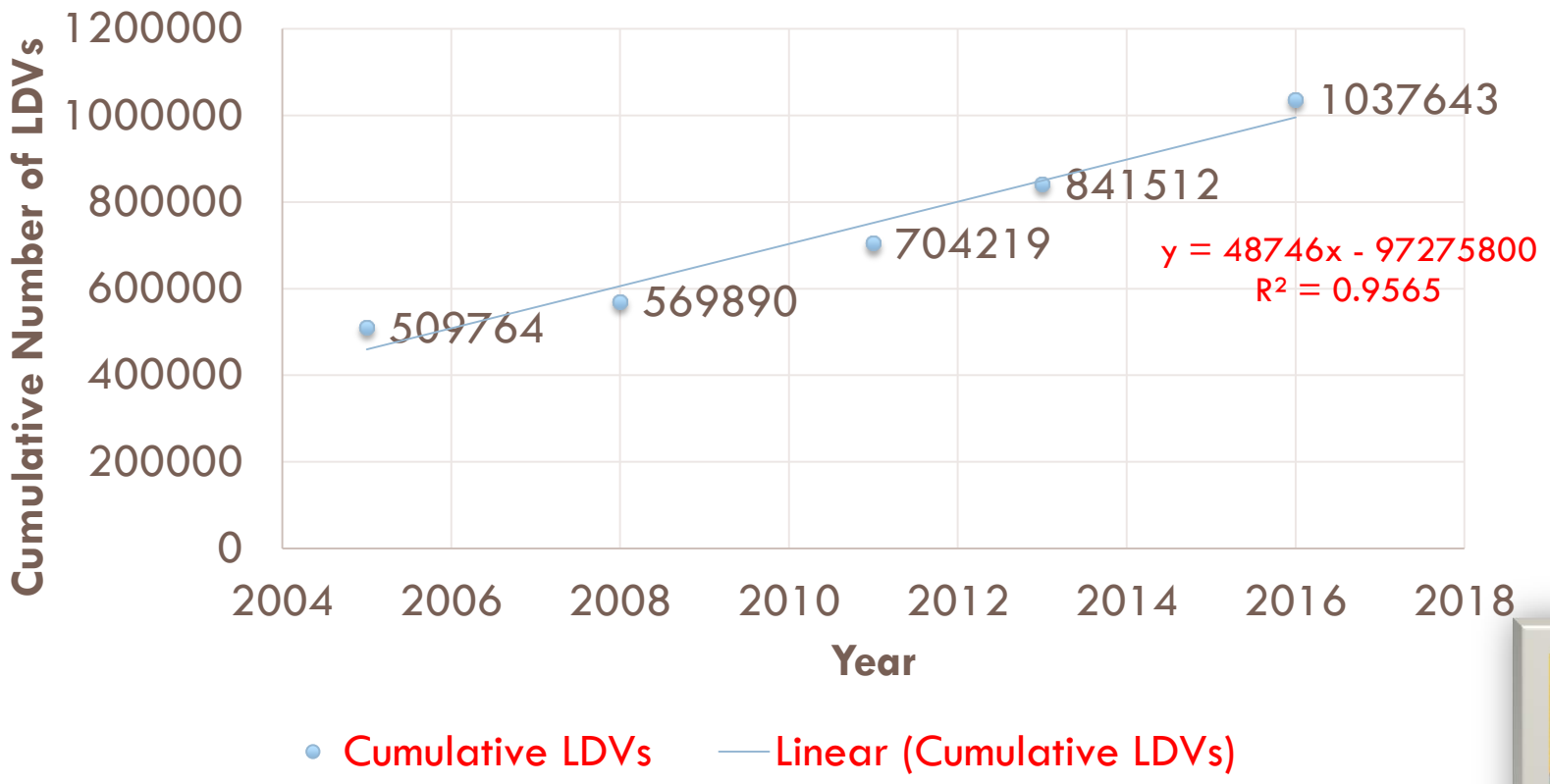
- New LDVs from 15.7% in `05 to 3.8% in `16

Year	2005	2008	2011	2013	2016	Total
New	1978	5235	5645	3660	1746	18264
	15.7%	18.8%	9.7%	5.5%	3.8%	8.6%
Used	10581	22595	52531	63222	44666	193595
	84.3%	81.2%	90.3%	94.5%	96.2%	91.4%
Total	12559	27830	58176	66882	46412	211859

- Based on the best line of fit and continuation of trend, LDVs are projected to be 119 739 in 2030 and 199 397 in 2050

Cumulative Number of Registered LDVs

- LDVs increased from 509 764 in `05 to 1 037 643 in `16

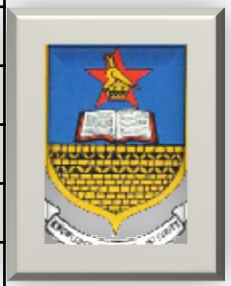


- Projections for 2030 and 2050 are 1 678 580 and 2 653 500

LDVs Classified by Engine Displacement

- Common engine size: 1501-2000, 2001-2500 and 2500-3500
- 73.7% of LDVs have engines with less than 2500 cc

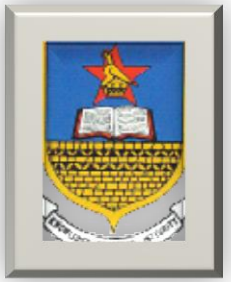
	Engine Displacement (cc)							Total
Year	<1000	1001-1300	1301-1500	1501-2000	2001-2500	2501-3500	3501+	
2005	34	1058	2043	4467	2135	2255	613	12605
	0.3%	8.4%	16.2%	35.4%	16.9%	17.9%	4.9%	
2008	94	10322	1753	3618	4714	6320	1092	27913
	0.3%	37.0%	6.3%	13.0%	16.9%	22.6%	3.9%	
2011	524	1126	9470	14645	14654	12704	5159	58282
	0.9%	1.9%	16.2%	25.1%	25.1%	21.8%	8.9%	
2013	595	1691	13200	16710	17278	14237	3241	66952
	0.9%	2.5%	19.7%	25.0%	25.8%	21.3%	4.8%	
2016	500	3469	9398	12677	10141	8690	1553	46428
	1.1%	7.5%	20.2%	27.3%	21.8%	18.7%	3.3%	
Total	1747	17666	35864	52117	48922	44206	11658	212180
	0.8%	8.3%	16.9%	24.6%	23.1%	20.8%	5.5%	



LDVs Classified by Fuel Type

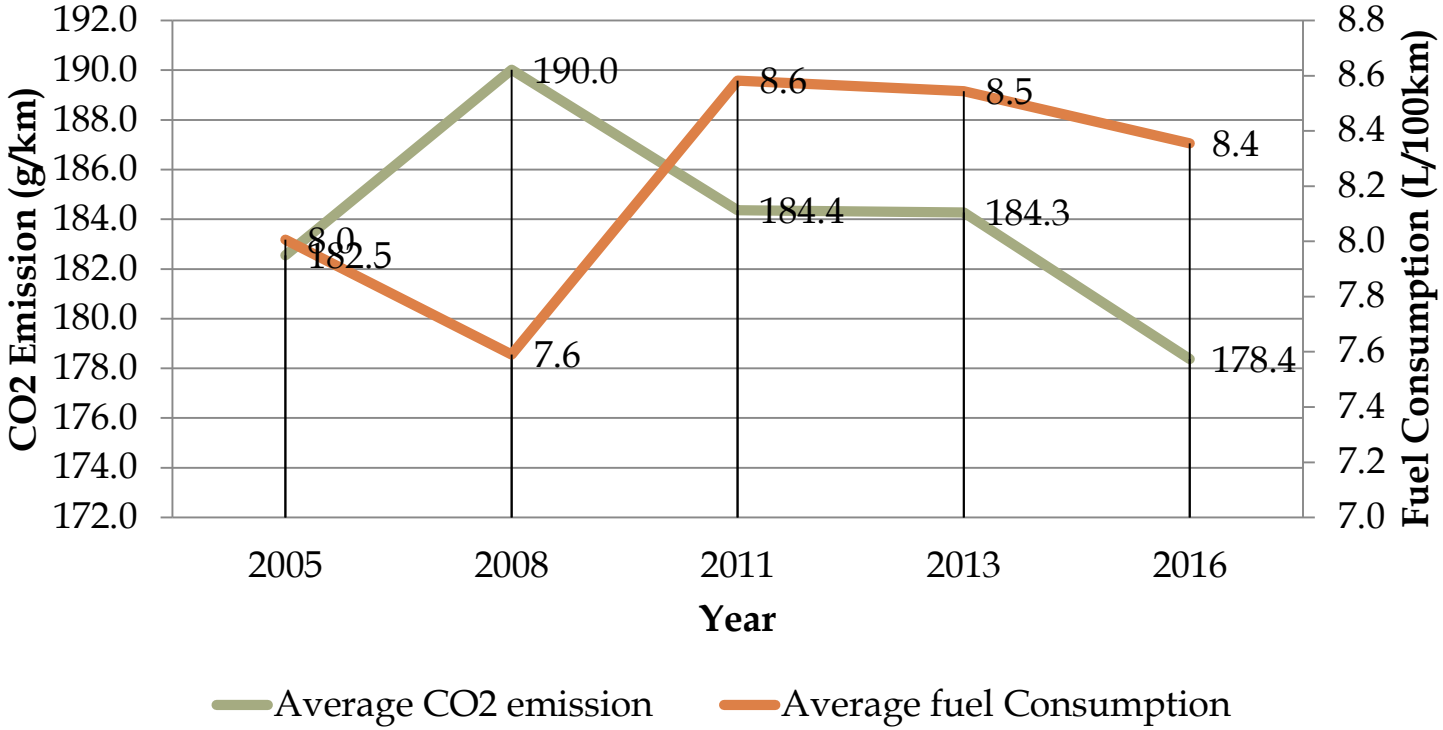
- Zimbabwean market is not responsive to dieselization
- Road diesel to petrol ratio decreased from 0.57 in 2005 to 0.291 in 2016

Fuel Type	2005	2008	2011	2013	2016	Total
Petrol	4819	18678	43031	49122	32698	148348
	38.2%	66.9%	73.8%	73.4%	70.9%	70.0%
Diesel	7225	9196	15193	17812	13419	62845
	57.3%	32.9%	26.1%	26.6%	29.1%	29.7%
Other	558	38	55	12	10	673
	4.4%	0.1%	0.1%	0.0%	0.0%	0.3%
Total	12602	27912	58279	66946	46127	211866
	6%	13%	28%	32%	22%	100%



Fuel Economy and CO_2 Emission Standards

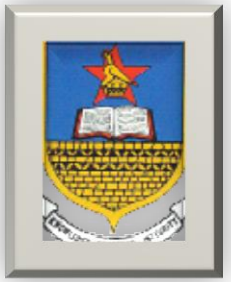
- Fuel consumption and CO2 emissions are decreasing but still high



Fuel Consumption Classified by Vehicle Condition

- New vehicles are more fuel efficient compared to used vehicles

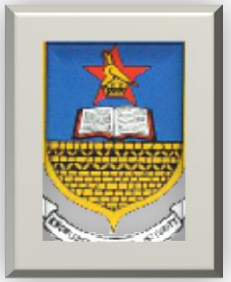
Year	Fuel Consumption (L/100km)		
	Used	New	Total
2005	8.6	7.9	8.0
2008	9.2	7.2	7.6
2011	8.6	8.6	8.6
2013	8.8	8.5	8.5
2016	8.8	8.3	8.4
Average	8.8	8.3	8.4



Average CO_2 Emissions Classified by Vehicle Condition

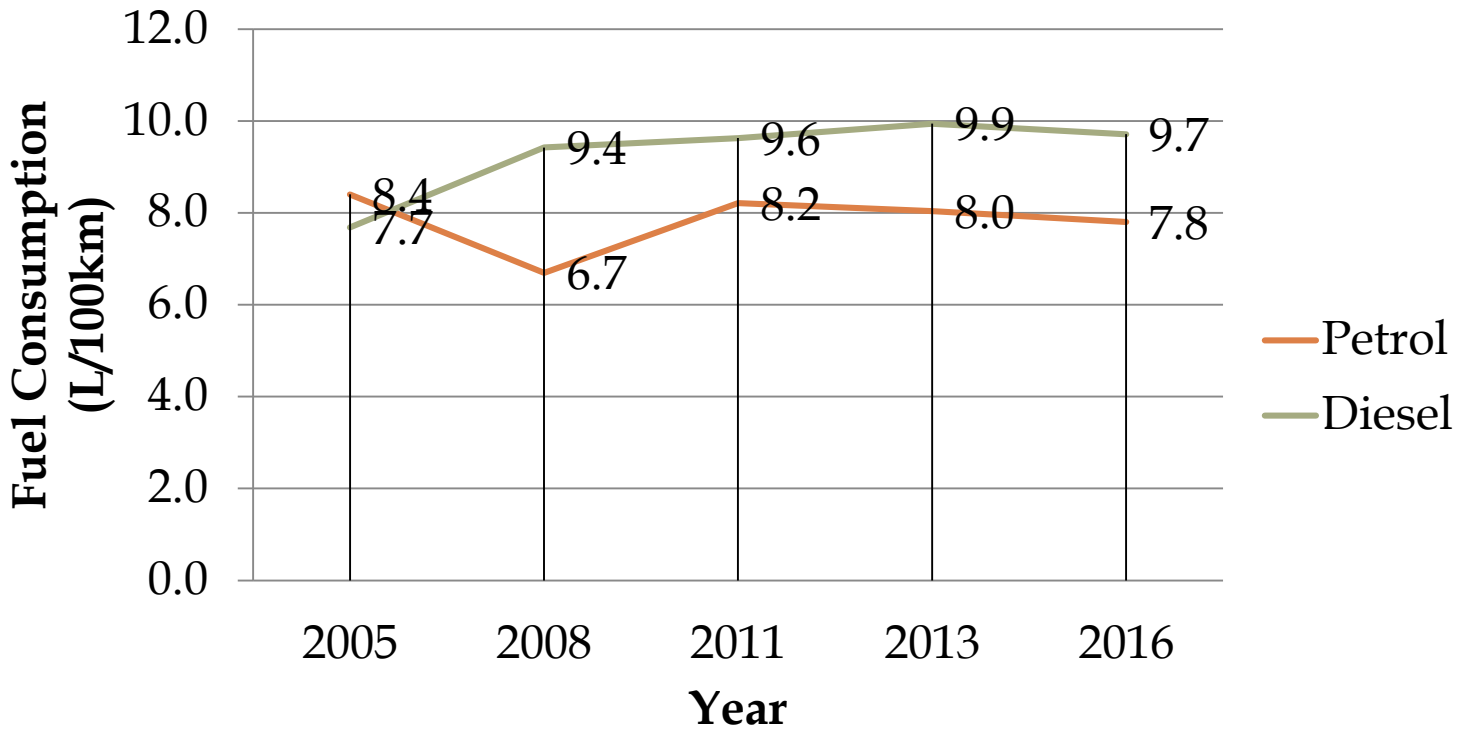
- Emissions of new vehicles are lower than emissions of used cars but both are still high

Year	Average CO_2 emissions (g/km)		
	Used	New	Total
2005	192.9	180.6	182.5
2008	205.7	186.4	190.0
2011	201.5	182.5	184.4
2013	205.1	183.1	184.3
2016	207.1	177.3	178.4
Average	203.0	181.8	183.7

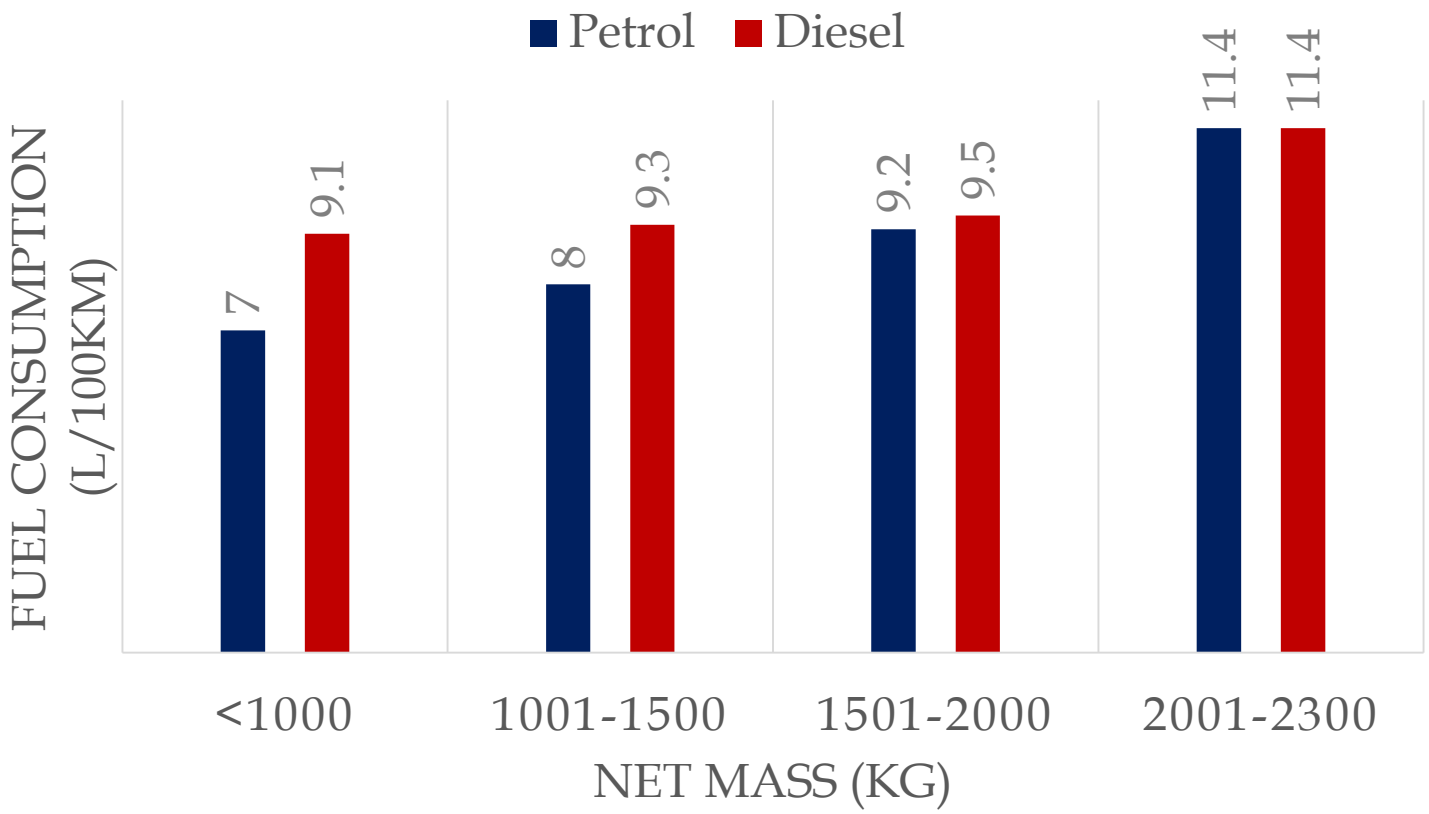


Average Fuel Consumption Classified by Fuel Type

- Fuel consumption of diesel powered LVDs is higher than that of petrol vehicles



Fuel Consumption Classified by Net Mass



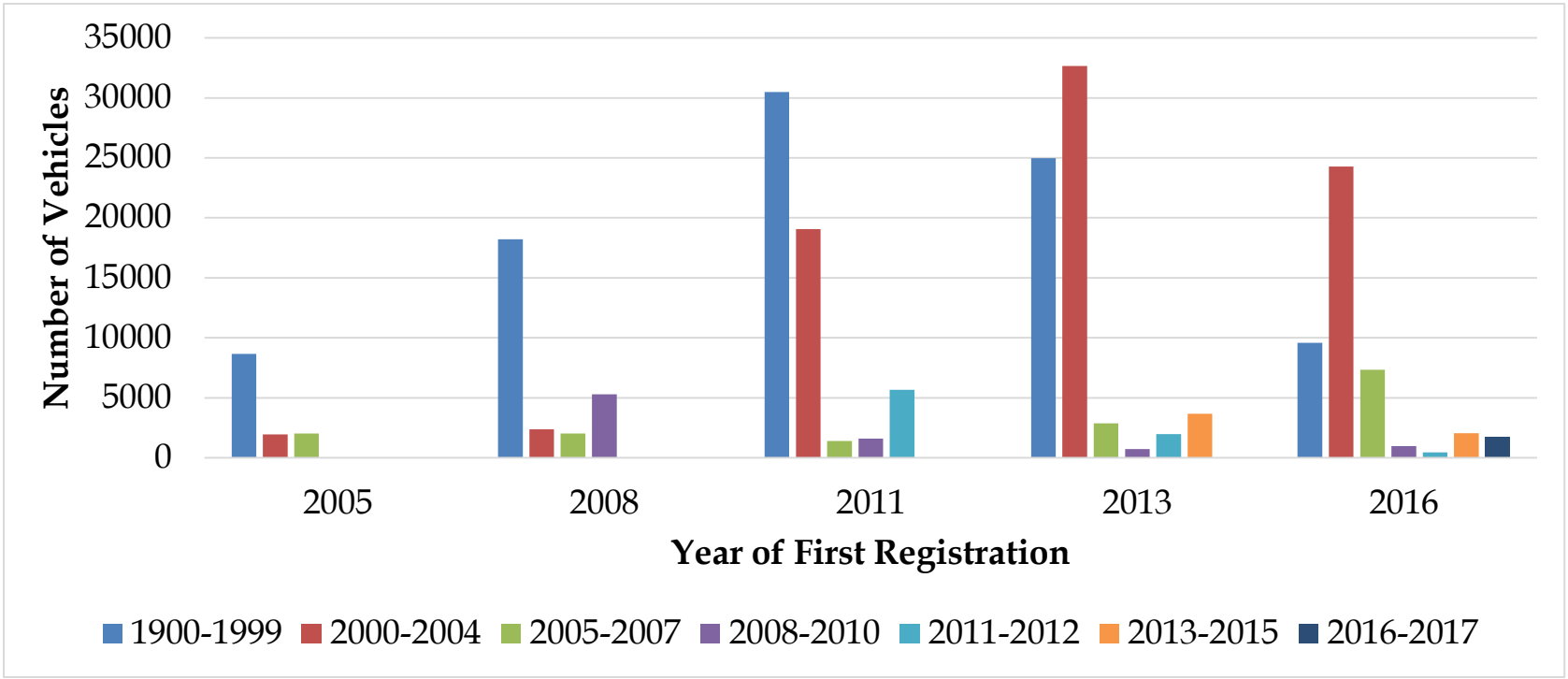
- Fuel consumption increases as net mass increases

Mean Age at Registration

- Mean age is 11 and age increased from 8.9 in `05 to 13.3 in `16
- Probably surtax being charged is not deterrent enough

Year	Mean Age at Registration
2005	8.9
2008	8.5
2011	10.9
2013	12.1
2016	13.3
Average	11.4

Vehicle Registration by Year of Production and First Registration

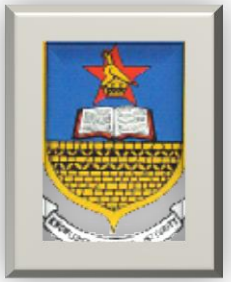


- Most registered vehicles were manufactured before 2005
- 52% registered in 2016 were manufactured between 2000 and `04
- 48% registered in 2013 were manufactured between 2000 & `04

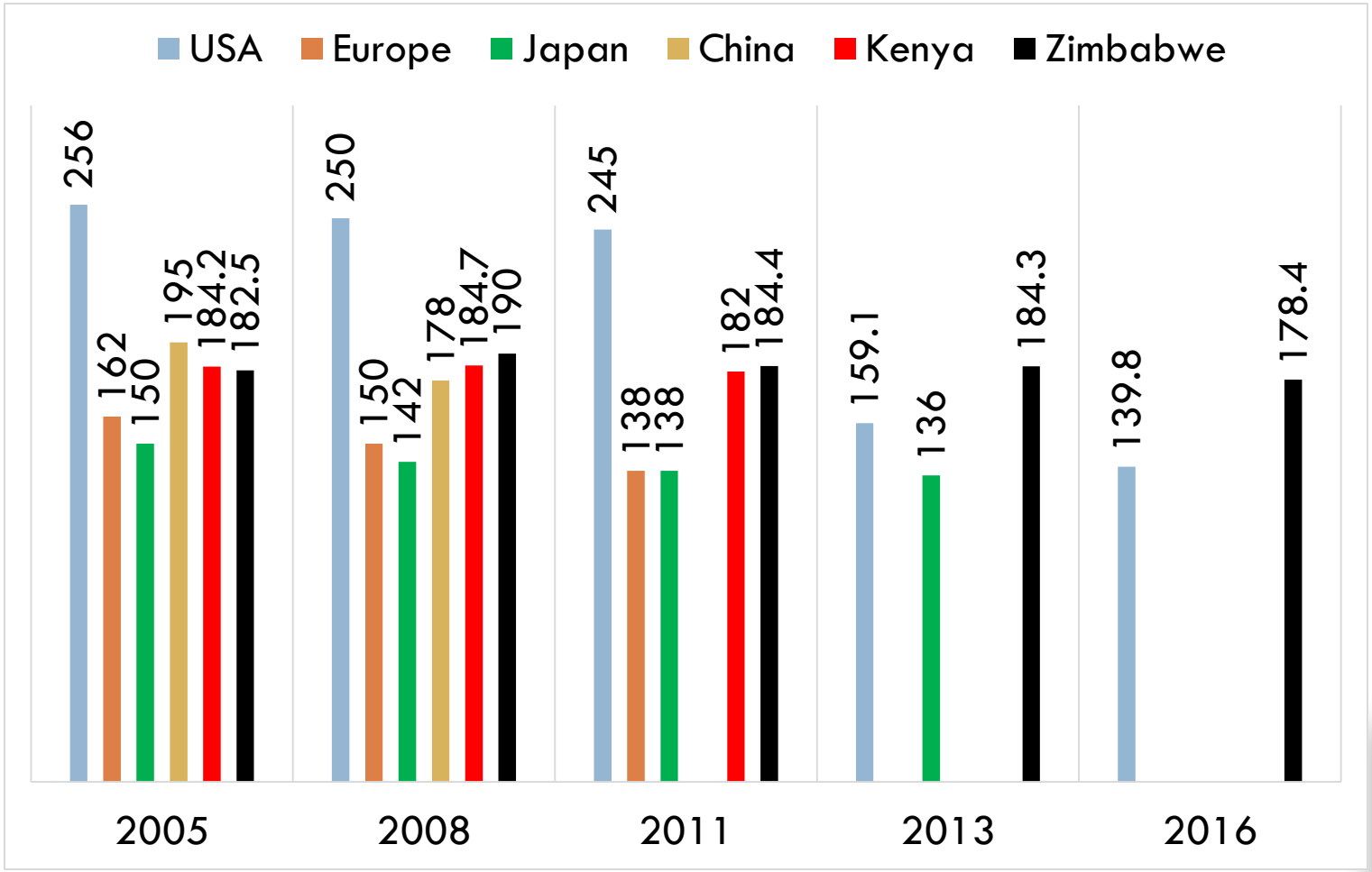
CO_2 and Fuel Consumption by Make

- LDVs with larger engines had higher fuel consumption and emissions. Eg Jeep and Isuzu

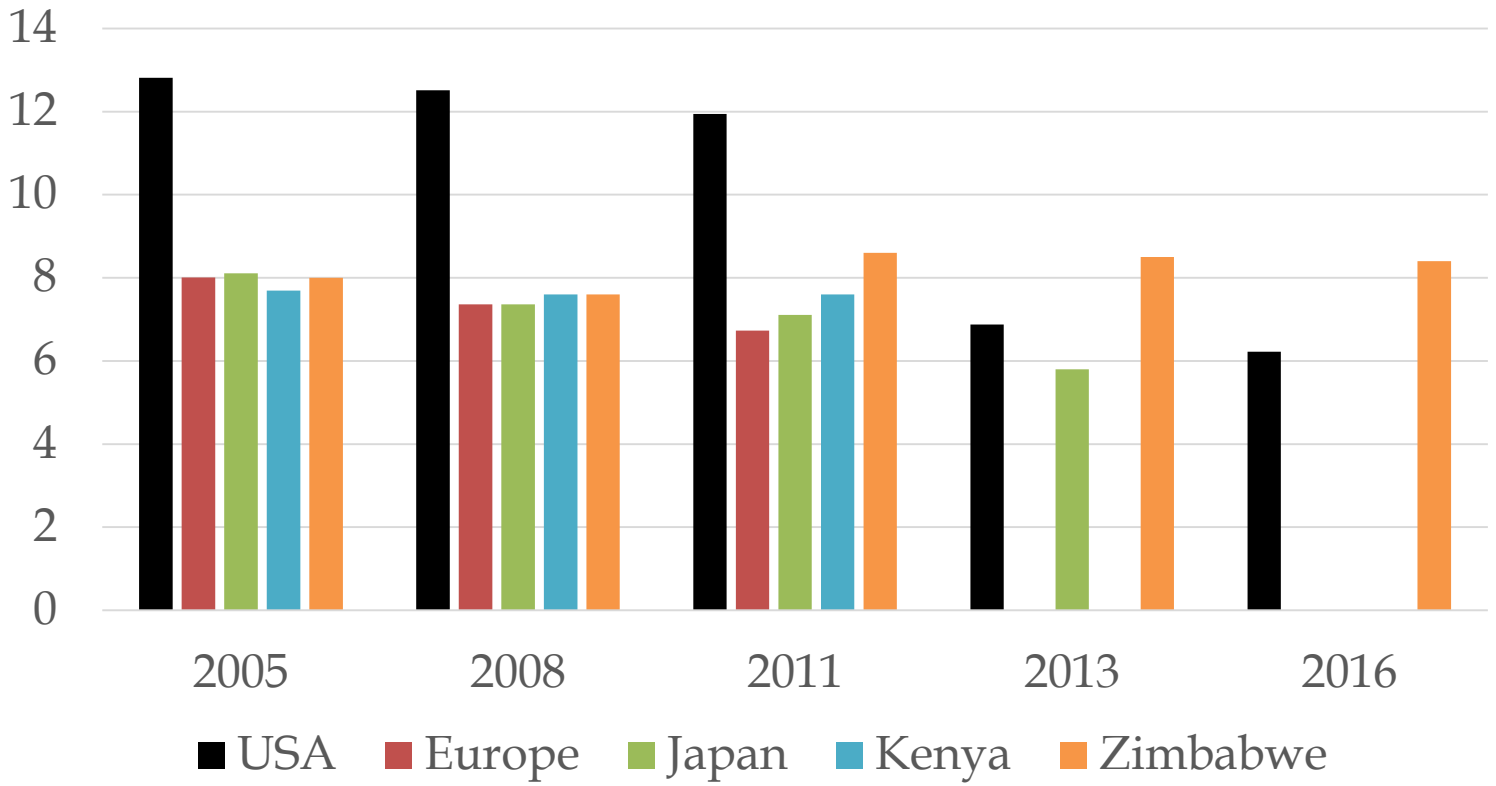
Vehicle Make	Average Fuel Consumption (L/100km)	Average CO_2 Emission (g/km)
Ford	5.9	169.3
Toyota	7.2	181.9
Peugeot	7.2	193.4
Audi	7.5	155.1
Hyundai	7.6	189.5
Honda	8.0	137.9
Chevrolet	8.4	183.7
Volkswagen	9.0	157.3
Mercedes Benz	9.2	172.3
Subaru	9.3	219.1
BMW	9.6	167.2
Volvo	9.7	238.5
Nissan	9.8	204.8
Mazda	10.4	172.5
Jeep	10.9	202.5
Isuzu	11.6	229.6
Other	9.0	220.4
Average	8.4	183.7



Comparison of CO_2 Emissions in Zimbabwe with Other Countries

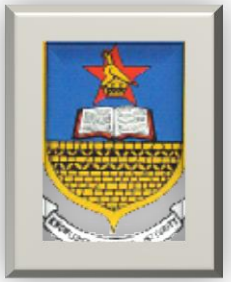


Comparison of Fuel Consumption in Zimbabwe with Other Countries



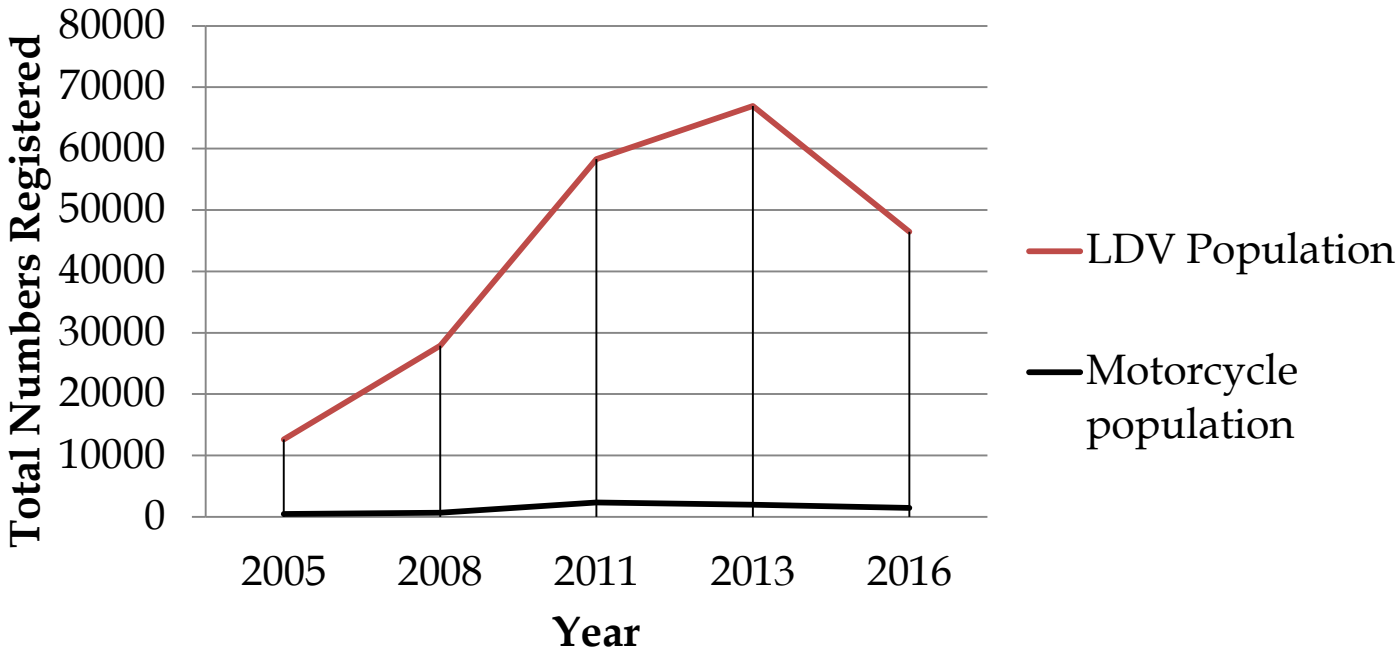
Hybrid Vehicles

- Hybrid vehicles use two or more power sources.
- Currently, the world's top selling hybrid vehicle is Toyota Prius.
- The dataset from CVR is silent about vehicles



Motorcycles Inventory

- In comparison to LDVs, the numbers of motorcycles are quite minimal.
- The costs in form of their contribution to deterioration of urban environment



Recommendations

- Incentivise use of hybrid vehicles which are fuel efficient
- Adopt dieselization initiative
- Incentivise importation of new vehicles which are fuel efficient
- Educate Zimbabweans on the need to use vehicles with smaller engine