Estimation of Fuel Consumption and CO_2 Emissions in Ghana, Methodology and Results

OUTLINE

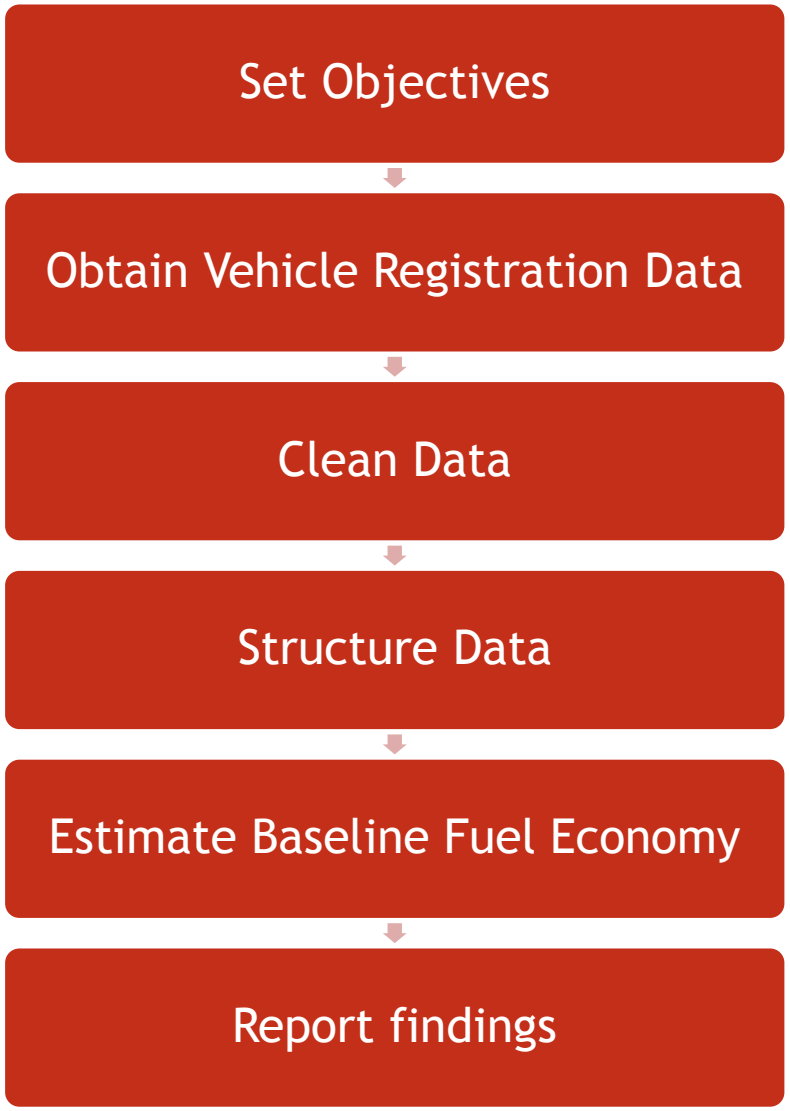
- OBJECTIVES OF STUDY
- METHODOLOGY
- OVERVIEW OF VEHICLE INVENTORY IN GHANA
- DATA CLEANING
- RESULTS OF DATA ANALYSIS
- CONCLUSION

OBJECTIVES OF STUDY

- To carry out an inventory of LDVs (new and used) imported between 2005 and 2016 using the GFEI Methodological Guide to Developing fuel economy database.
- Use the data from the inventory to estimate baseline and average fuel economy for Ghana
- Estimate CO2 emissions for LDVs imported between 2005 and 2016
- Review policies and regulations in place to promote the use of cleaner and fuel efficient LDVs in Ghana.
- Conduct Cost Benefit analysis of key policy interventions to promote fuel economy in Ghana
- Provide policy recommendations aimed at reducing carbon emissions and promoting vehicle fuel efficiency

METHODOLOGY

-GFEI STEPS



Assumptions

- Vehicle import data was used for this study instead of vehicle registration data due to the unavailability of digitized registration data on individual LDVs within the manner prescribed by the IEA data frame of key attributes on auto fuel economy. We presume a strong correlation between the import data and registered LDVs to produce results.

- [illegible] assumption that there would be a marginal variance between the two transmission types of the same vehicle.

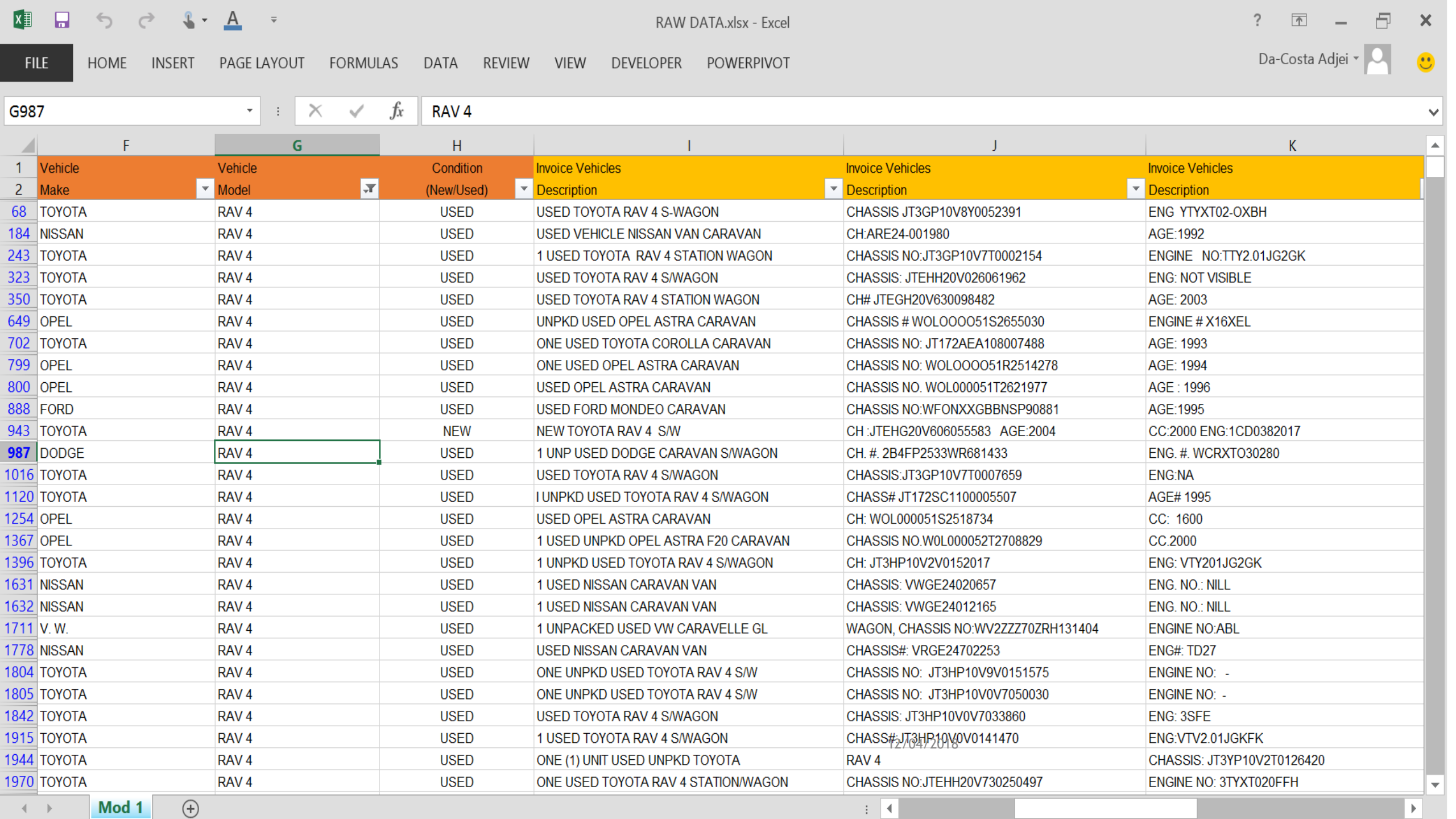
12/04/2018

OVERVIEW OF VEHICLE INVENTORY IN GHANA

Year	No. of LDVs Imported
2005	66,036
2006	69,316
2007	90,312
2008	96,128
2009	82,301
2010	NIL
2011	26,297
2012	178,948
2013	78,835
2014	112,921
2015	105,366
2016	112,424
Total	1,018,884

Gaps Identified in the data

- Incomplete Data
  - 2016 Jan-Oct
  - No data for 2010
  - 2011 No data for Nov and about 1 week transaction for each month.
- Spelling Mistakes
- Wrong Inputs
- Incomplete information on LDVs



	F	G	H	I	J	K
1	Vehicle	Vehicle	Condition	Invoice Vehicles	Invoice Vehicles	Invoice Vehicles
2	Make	Model	(New/Used)	Description	Description	Description
68	TOYOTA	RAV 4	USED	USED TOYOTA RAV 4 S-WAGON	CHASSIS JT3GP10V8Y0052391	ENG YTYXT02-OXBH
184	NISSAN	RAV 4	USED	USED VEHICLE NISSAN VAN CARAVAN	CH:ARE24-001980	AGE:1992
243	TOYOTA	RAV 4	USED	1 USED TOYOTA RAV 4 STATION WAGON	CHASSIS NO:JT3GP10V7T0002154	ENGINE NO:TTY2.01JG2GK
323	TOYOTA	RAV 4	USED	USED TOYOTA RAV 4 S/WAGON	CHASSIS: JTEHH20V026061962	ENG: NOT VISIBLE
350	TOYOTA	RAV 4	USED	USED TOYOTA RAV 4 STATION WAGON	CH# JTEGH20V630098482	AGE: 2003
649	OPEL	RAV 4	USED	UNPKD USED OPEL ASTRA CARAVAN	CHASSIS # WOLOOOO51S2655030	ENGINE # X16XEL
702	TOYOTA	RAV 4	USED	ONE USED TOYOTA COROLLA CARAVAN	CHASSIS NO: JT172AEA108007488	AGE: 1993
799	OPEL	RAV 4	USED	ONE USED OPEL ASTRA CARAVAN	CHASSIS NO: WOLOOOO51R2514278	AGE: 1994
800	OPEL	RAV 4	USED	USED OPEL ASTRA CARAVAN	CHASSIS NO. WOL000051T2621977	AGE : 1996
888	FORD	RAV 4	USED	USED FORD MONDEO CARAVAN	CHASSIS NO:WFONXXGBBNSP90881	AGE:1995
943	TOYOTA	RAV 4	NEW	NEW TOYOTA RAV 4 S/W	CH :JTEHG20V606055583 AGE:2004	CC:2000 ENG:1CD0382017
987	DODGE	RAV 4	USED	1 UNP USED DODGE CARAVAN S/WAGON	CH. #. 2B4FP2533WR681433	ENG. #. WCRXTO30280
1016	TOYOTA	RAV 4	USED	USED TOYOTA RAV 4 S/WAGON	CHASSIS:JT3GP10V7T0007659	ENG:NA
1120	TOYOTA	RAV 4	USED	I UNPKD USED TOYOTA RAV 4 S/WAGON	CHASS# JT172SC1100005507	AGE# 1995
1254	OPEL	RAV 4	USED	USED OPEL ASTRA CARAVAN	CH: WOL000051S2518734	CC: 1600
1367	OPEL	RAV 4	USED	1 USED UNPKD OPEL ASTRA F20 CARAVAN	CHASSIS NO.W0L000052T2708829	CC.2000
1396	TOYOTA	RAV 4	USED	1 UNPKD USED TOYOTA RAV 4 S/WAGON	CH: JT3HP10V2V0152017	ENG: VTY201JG2GK
1631	NISSAN	RAV 4	USED	1 USED NISSAN CARAVAN VAN	CHASSIS: VWGE24020657	ENG. NO.: NILL
1632	NISSAN	RAV 4	USED	1 USED NISSAN CARAVAN VAN	CHASSIS: VWGE24012165	ENG. NO.: NILL
1711	V. W.	RAV 4	USED	1 UNPACKED USED VW CARAVELLE GL	WAGON, CHASSIS NO:WV2ZZZ70ZRH131404	ENGINE NO:ABL
1778	NISSAN	RAV 4	USED	USED NISSAN CARAVAN VAN	CHASSIS#: VRGE24702253	ENG#: TD27
1804	TOYOTA	RAV 4	USED	ONE UNPKD USED TOYOTA RAV 4 S/W	CHASSIS NO: JT3HP10V9V0151575	ENGINE NO: -
1805	TOYOTA	RAV 4	USED	ONE UNPKD USED TOYOTA RAV 4 S/W	CHASSIS NO: JT3HP10V0V7050030	ENGINE NO: -
1842	TOYOTA	RAV 4	USED	USED TOYOTA RAV 4 S/WAGON	CHASSIS: JT3HP10V0V7033860	ENG: 3SFE
1915	TOYOTA	RAV 4	USED	1 USED TOYOTA RAV 4 S/WAGON	CHASS#:JT3HP10V0V0141470	ENG:VTV2.01JGKFK
1944	TOYOTA	RAV 4	USED	ONE (1) UNIT USED UNPKD TOYOTA	RAV 4	CHASSIS: JT3YP10V2T0126420
1970	TOYOTA	RAV 4	USED	ONE USED TOYOTA RAV 4 STATION/WAGON	CHASSIS NO:JTEHH20V730250497	ENGINE NO: 3TYXT020FFH

L1 Chassis

	F	G	H	Q	R	S	T	U	V
1	Vehicle	Vehicle	Condition	Vehicle Year of	Mileage	Cubic	Cylinder	Horse	Vehicle
2	Make	Model	(New/Used)	Make		capacity	Capacity	Power	Fuel Type
264	OPEL	ASTRA	USED	1992	0	1600	0	0	FO01
265	V. W.		USED	1994	0	1800	0	0	FO01
266	FIAT		USED	1993	0	2	0	0	FO01
267	FIAT		USED	1990	0	2	0	0	FO01
268	FIAT		USED	1990	0	1	0	0	FO01
269	OPEL	ASTRA	USED	1992	181630	1600	0	0	FO01
270		VOYAGER	USED		0	0	0	0	
271	V. W.		USED	1996	156553	1600	0	0	FO01
272	OPEL	ASTRA	USED	1995	79745	1600	0	0	FO01
273	OPEL	ASTRA	USED	1995	79745	1600	0	0	FO01
274	MAZDA		USED	1989	0	3500	0	4	FO02
275	FORD		USED		0	0	0	0	
276	OPEL	ASTRA	USED	1993	0	1400	0	1400	FO01
277	OPEL	ASTRA	USED	1994	0	1400	0	0	FO01
278	GEO		USED	1992	0	1360	0	0	FO01
279	TOYOTA	COROLLA	USED		0	0	0	0	
280	KIA	KIA	USED	1998	108619	2184	0	2184	FO02
281	SEAT	TOLEDO	USED	1992	165272	1600	0	1600	FO01
282	NISSAN		USED	2000	0	3300	0	0	FO01
283	DODGE	RAM	USED	1994	453743	5900	0	0	FO01
284	DODGE	RAM	USED	1994	148469	5900	0	0	FO01
285	OPEL	ASTRA	USED	1994	203620	1600	0	0	FO01
286	OPEL	ASTRA	USED	1994	0	1400	0	0	FO01
287			USED	1984	0	13244	0	0	FO02
288	LANCIA	LANCIA	USED	1995	0	1800	0	0	FO01
289	MERCEDES	BENZ	USED	1983	195448	1997	0	0	FO02
290	MERCEDES	BENZ	USED	1983	195448	1997	0	0	FO02

02/04/2018

Data Cleaning

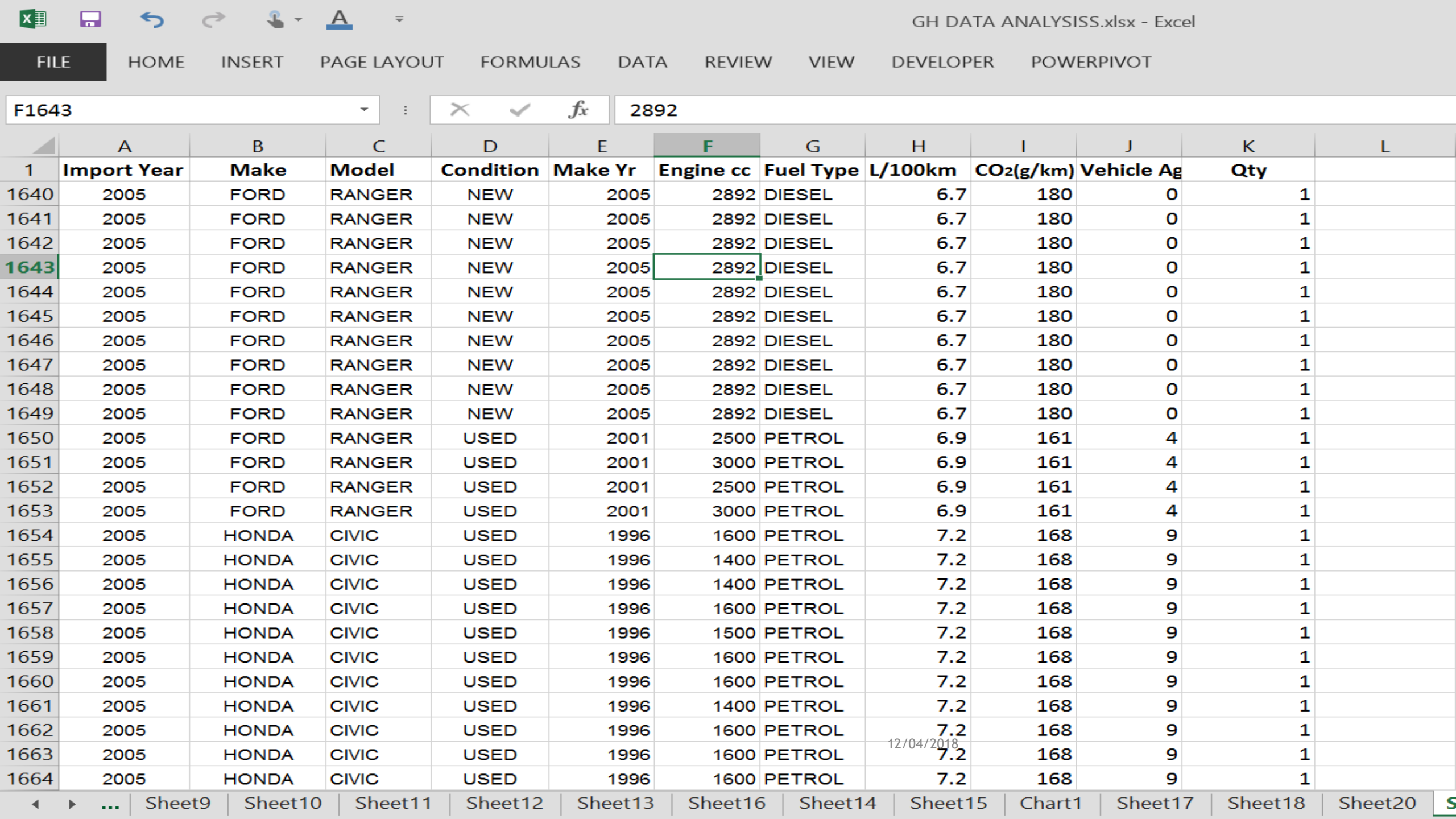
- (i) HDVs, motorcycles, trailers, combined harvesters etc; (ii) incomplete entries i.e. datasets that did not contain all variables required for the studies; (iii) For the purpose of this study, LDVs which were above 10 years old on the date of import were also removed
- Identify and Isolate relevant key attributes (column headlines) based on IEA Data frame of key attributes from the dataset
- Merging of synonymous information e.g Chevrolet and Chevy
- Correction of spelling Mistakes
- Removal of wrong inputs
- Systematic removal of incomplete information on vehicle
- Addition of other relevant fields

USEFUL WEBSITES

- https://car-emissions.com/cars
- http://www.carfolio.com/specifications/models
- http://www.epa.gov/fueleconomy/
- http://www.edmunds.com/
- http://carfueldata.direct.gov.uk/
- http://www.nextgreencar.com/

Fuel Economy Values

Row Labels	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Grand Total
ALFA																							
ROMEO	8.2	8.2	8.2	8.5	8.5	8.6	8.7	8.6	8.4	7.9	8.3	8.3	8.4	8.2	8.2	8.2	8.2	6.5	6.6	6.4	6.4	6.6	
BMW																							
316i	9.0	9.0	9.0	9.0	9.0	7.8	7.8	8.5	8.4														
CHEVROLET																							
PRIZM	7.3	7.3	7.3	7.5	7.5	7.9	8.3	8.0	7.6	7.4	7.6	7.6	7.8	7.3	7.3	7.3	6.6	6.3	6.3	6.2	6.1	6.3	
DAEWOO																							
MATIZ	8.3	8.3	8.9	9.1	9.1	8.9	8.9	8.9	8.0	7.8	8.5	8.4	8.7	8.3	8.3	8.3	6.6	6.2	6.2	6.0	6.0	6.1	
NUBIRA	8.7	8.7	9.4	9.6	9.6	9.1	9.6	9.1	8.1	7.8	8.7	8.6	8.8	8.7	8.7	8.7	6.7	6.3	6.3	6.0	6.0	6.1	
TICO	8.7	8.7	9.4	9.6	9.6	9.1	9.0	9.1	8.1	7.8	8.7	8.6	8.8	8.7	8.7	8.7	6.7	6.2	6.3	6.0	6.0	6.1	
DODGE																							
RAM	8.6	8.6	9.9	10.2	10.2	9.1	9.1	9.1	8.0	7.7	8.6	8.6	8.8	8.6	8.6	8.6	6.6	6.1	6.1	5.8	5.8	5.8	
FORD																							
FOCUS	6.5	6.5	6.6	6.6	6.6	6.8	6.9	6.8	6.7	6.6	6.7	6.6	6.8	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.4	6.4	
RANGER	6.5	6.5	6.6	6.6	6.6	6.8	6.9	6.8	6.7	6.6	6.7	6.6	6.8	6.5	6.5	6.5	6.5	6.4	6.4	6.3	6.4	6.4	
HONDA																							
ACCORD	7.2	7.2	7.3	7.3	7.3	7.5	7.8	7.6	7.4	7.3	7.4	7.3	7.5	7.2	7.2	7.2	6.8	6.5	6.6	6.4	6.4	6.6	
CIVIC	7.2	7.2	7.3	7.3	7.2	7.5	7.8	7.6	7.4	7.3	7.4	7.5	7.2	7.2	7.2	6.8	6.5	6.6	6.4	6.4	6.4	6.6	
HYUNDAI																							
ACCENT	6.6	6.6	6.8	6.9	6.9	7.4	7.8	7.5	7.2	7.0	7.0	7.0	7.3	6.6	6.6	6.6	6.5	6.2	6.2	6.0	6.0	6.1	
ELANTRA	6.5	6.6	6.8	6.9	6.9	7.4	7.8	7.5	7.2	7.0	7.0	7.0	7.3	6.6	6.6	6.6	6.5	6.2	6.2	6.0	6.0	6.1	
SANTE FE	6.6	6.6	6.8	6.9	6.9	7.4	7.8	7.5	7.2	7.0	7.0	7.0	7.3	6.6	6.6	6.6	6.5	6.2	6.2	6.0	6.0	6.2	
KIA																							
PRIDE	7.1	7.5	7.5	7.5	7.7	7.3	8.0	7.2	8.0	7.2	8.6	8.6	8.2	8.6	8.6	8.5	8.5	8.1	8.1	8.1			
SPORTAGE	14.7	14.7	15.5	14.7	14.7	14.7	14.7	15.5	11.7	15.5	14.7	14.7	14.7	14.7	14.7	14.7	12.7	12.2	12.2	11.2	11.7	11.7	11.7
MERCEDES																							
BENZ	7.8	7.8	7.8	7.8	7.8	7.9	7.9	7.9	7.8	7.8	7.8	7.8	7.9	7.8	7.8	7.8	7.5	7.4	7.5	7.5	7.5	7.6	
MITSUBISHI																							
L200	8.2	8.2	8.4	8.4	8.5	8.6	8.5	8.1	7.9	8.3	8.3	8.4	8.2	8.2	8.2	8.2	7.0	6.7	6.8	6.6	6.6	6.9	
PAJERO	8.2	8.2	8.4	8.4	8.5	8.6	8.5	8.1	7.9	8.3	8.3	8.4	8.2	8.2	8.2	8.2	7.0	6.7	6.8	6.6	6.6	6.9	
NISSAN																							
PATHFINDER	7.4	7.4	7.5	7.6	7.6	7.9	8.2	8.0	7.6	7.5	7.6	7.8	7.4	7.4	7.4	6.8	6.4	6.5	6.3	6.3	6.4	7.1	
PATROL	7.4	7.4	7.4	7.4	7.4	7.9	8.2	8.0	7.6	7.5	7.7	7.6	7.8	7.4	7.4	7.4	6.8	6.4	6.3	6.3	6.3	6.4	
SENTRA	7.4	7.4	7.5	7.6	7.6	7.9	8.2	8.0	7.6	7.5	7.6	7.6	7.8	7.4	7.4	7.5	6.8	6.4	6.5	6.3	6.3	6.4	
URVAN	7.4	7.4	7.5	7.6	7.9	8.2	8.0	7.6	7.5	7.6	7.6	7.8	7.4	7.4	7.4	7.4	6.8	6.8	6.4	6.3	6.3	6.3	6.4
OPEL																							



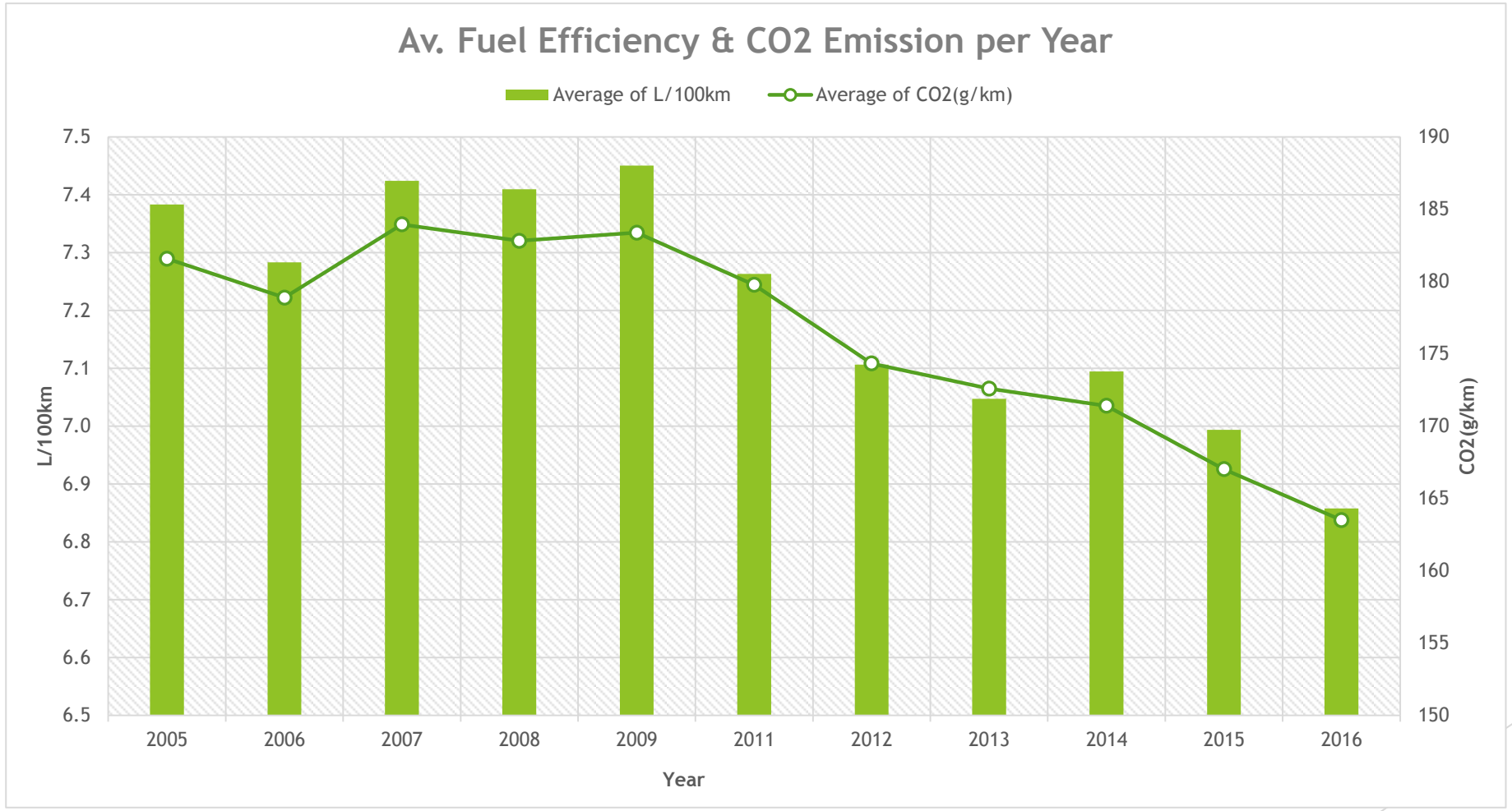
	A	B	C	D	E	F	G	H	I	J	K	L
1	Import Year	Make	Model	Condition	Make Yr	Engine cc	Fuel Type	L/100km	CO_2(g/km)	Vehicle Ag	Qty	
1640	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1641	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1642	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1643	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1644	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1645	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1646	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1647	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1648	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1649	2005	FORD	RANGER	NEW	2005	2892	DIESEL	6.7	180	0	1	
1650	2005	FORD	RANGER	USED	2001	2500	PETROL	6.9	161	4	1	
1651	2005	FORD	RANGER	USED	2001	3000	PETROL	6.9	161	4	1	
1652	2005	FORD	RANGER	USED	2001	2500	PETROL	6.9	161	4	1	
1653	2005	FORD	RANGER	USED	2001	3000	PETROL	6.9	161	4	1	
1654	2005	HONDA	CIVIC	USED	1996	1600	PETROL	7.2	168	9	1	
1655	2005	HONDA	CIVIC	USED	1996	1400	PETROL	7.2	168	9	1	
1656	2005	HONDA	CIVIC	USED	1996	1400	PETROL	7.2	168	9	1	
1657	2005	HONDA	CIVIC	USED	1996	1600	PETROL	7.2	168	9	1	
1658	2005	HONDA	CIVIC	USED	1996	1500	PETROL	7.2	168	9	1	
1659	2005	HONDA	CIVIC	USED	1996	1600	PETROL	7.2	168	9	1	
1660	2005	HONDA	CIVIC	USED	1996	1600	PETROL	7.2	168	9	1	
1661	2005	HONDA	CIVIC	USED	1996	1400	PETROL	7.2	168	9	1	
1662	2005	HONDA	CIVIC	USED	1996	1600	PETROL	7.2	168	9	1	
1663	2005	HONDA	CIVIC	USED	1996	1600	PETROL	7.2	168	9	1	
1664	2005	HONDA	CIVIC	USED	1996	1600	PETROL	7.2	168	9	1	

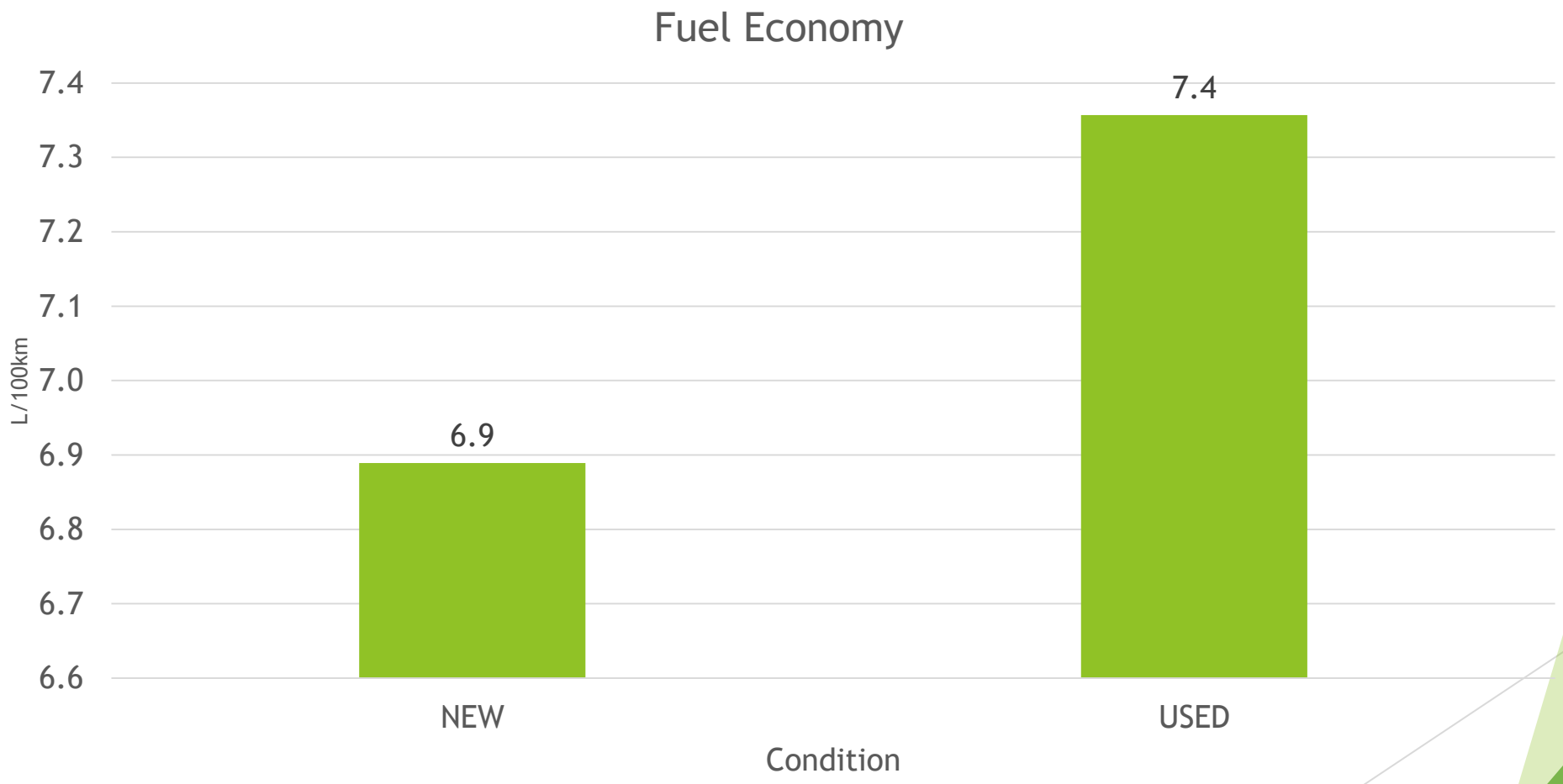
Results of Data Analysis

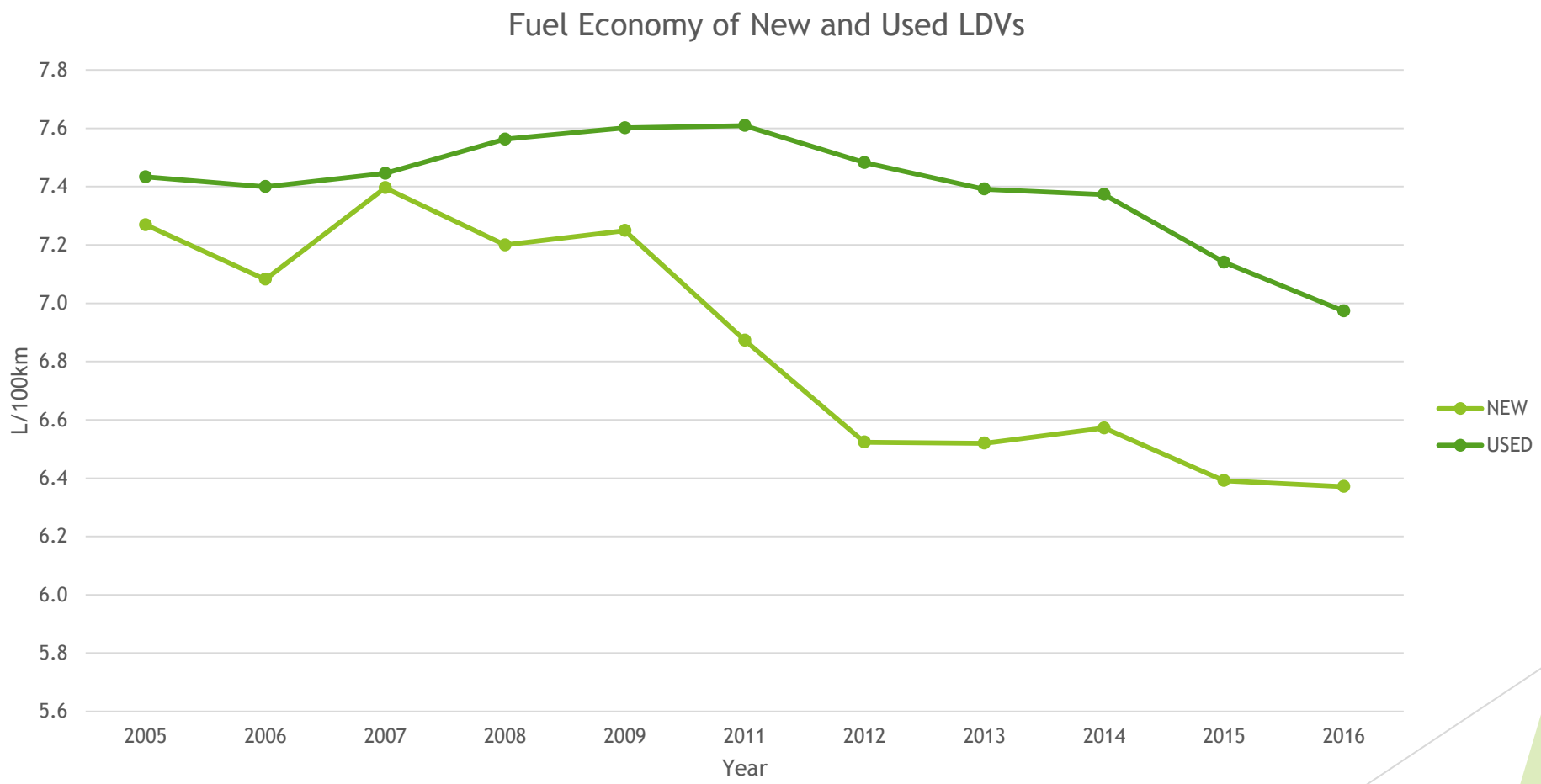
Av. Fuel Economy and CO_2 Emission

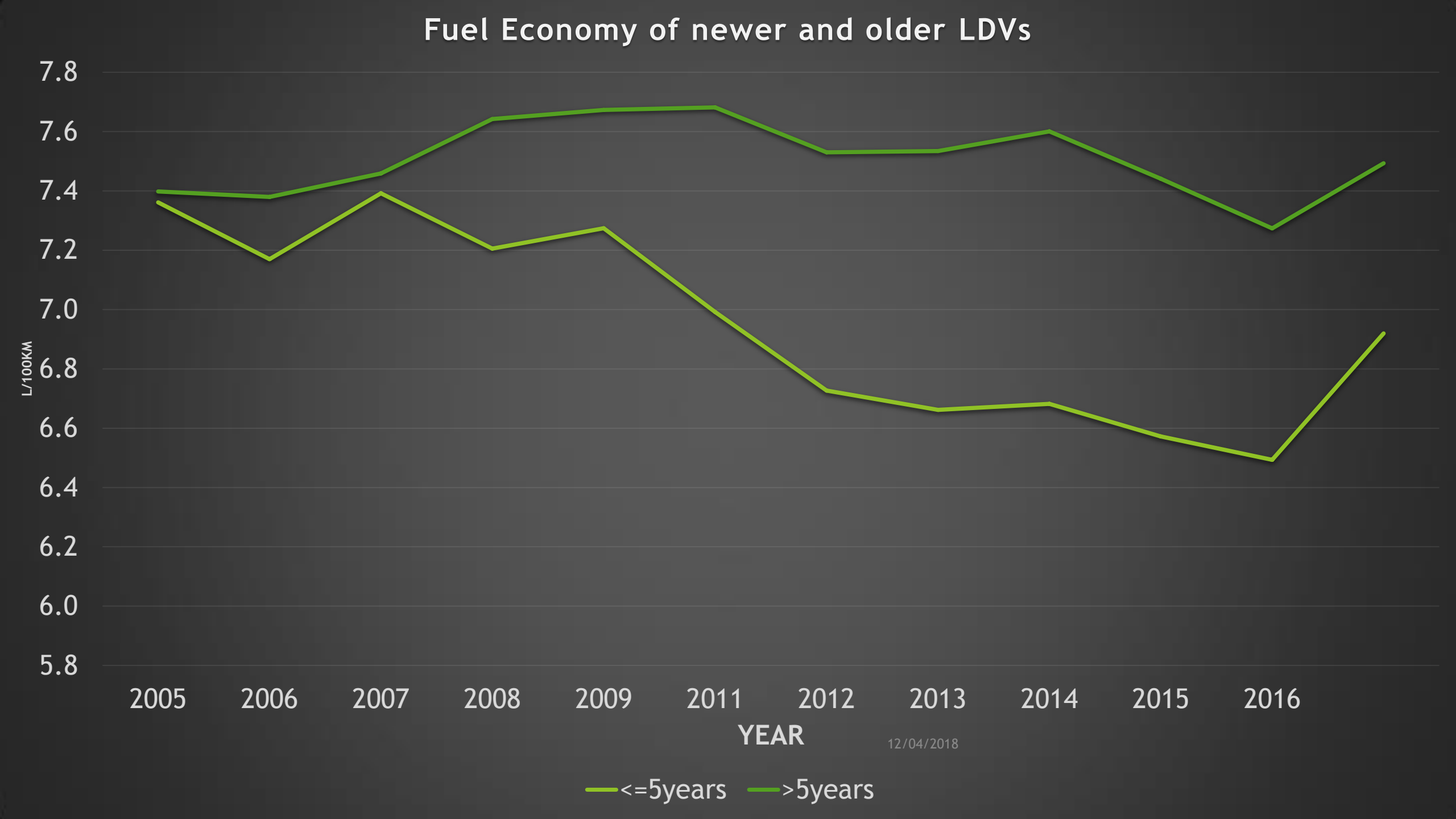
Years	Av. L/100km	Av. CO2(g/km)
2005	7.4	182
2006	7.3	179
2007	7.4	184
2008	7.4	183
2009	7.5	183
2011	7.3	180
2012	7.1	174
2013	7.0	173
2014	7.1	171
2015	7.0	167
2016	6.9	164
Grand Total	7.2	176

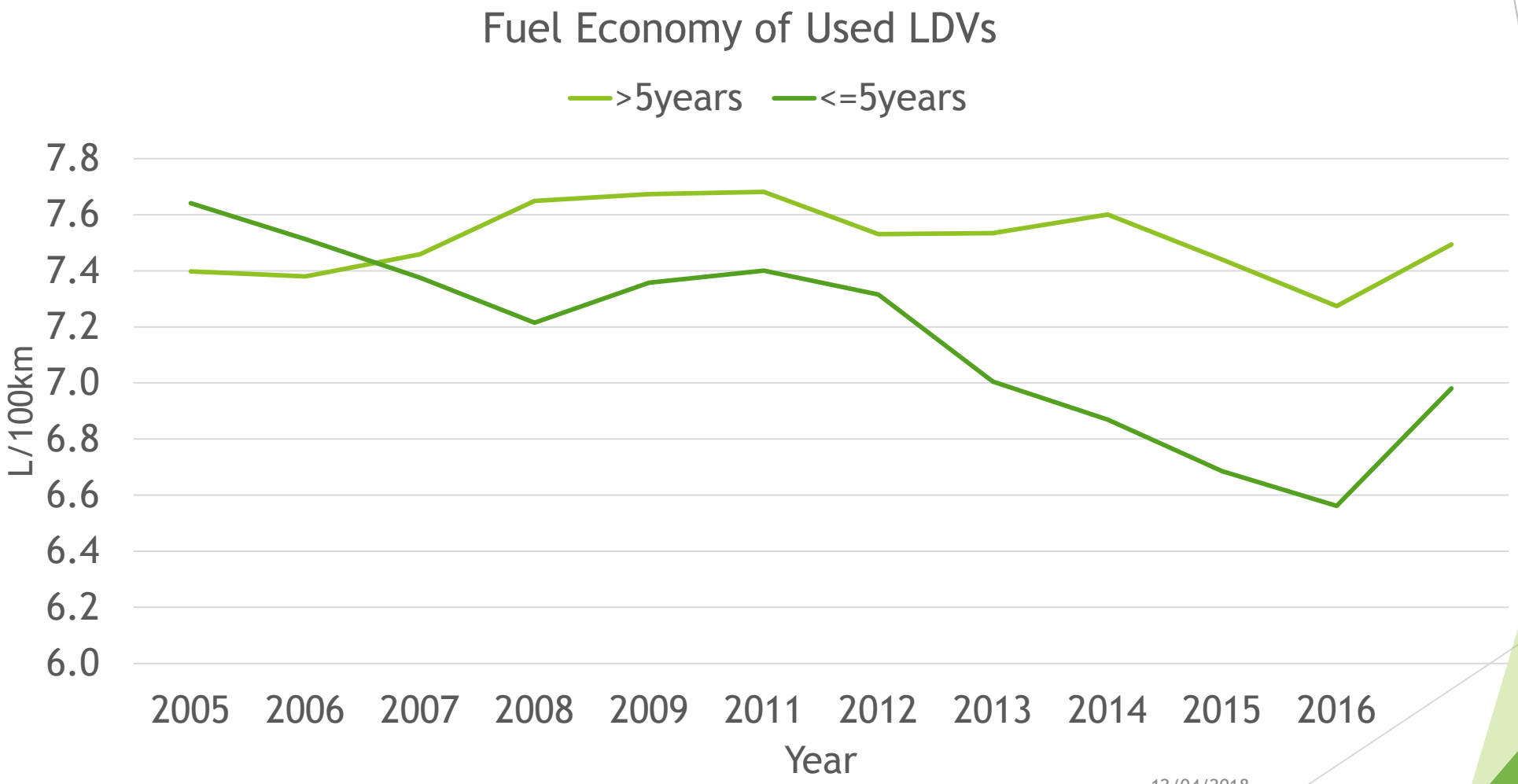
TABLES AND GRAPHS

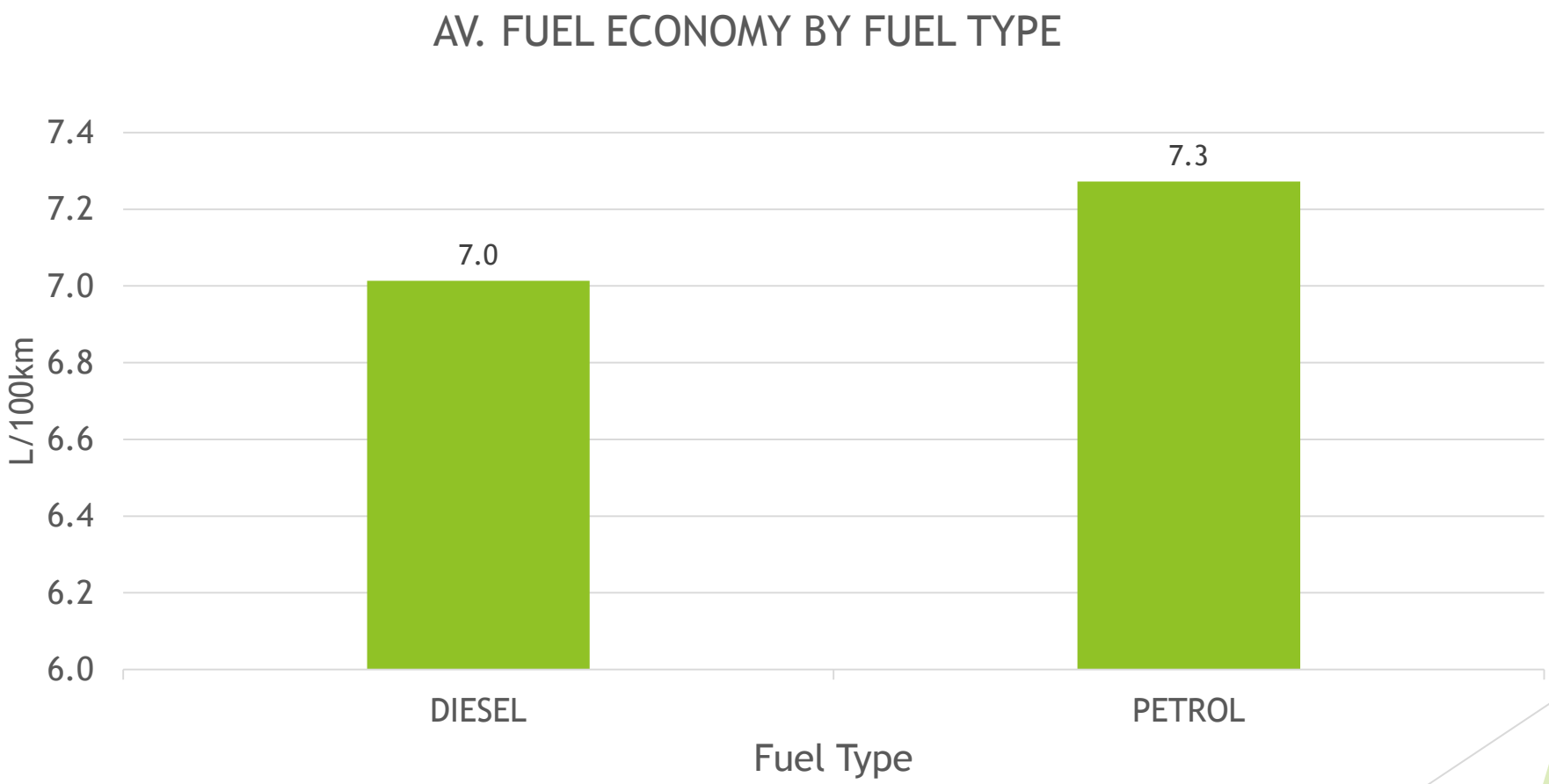


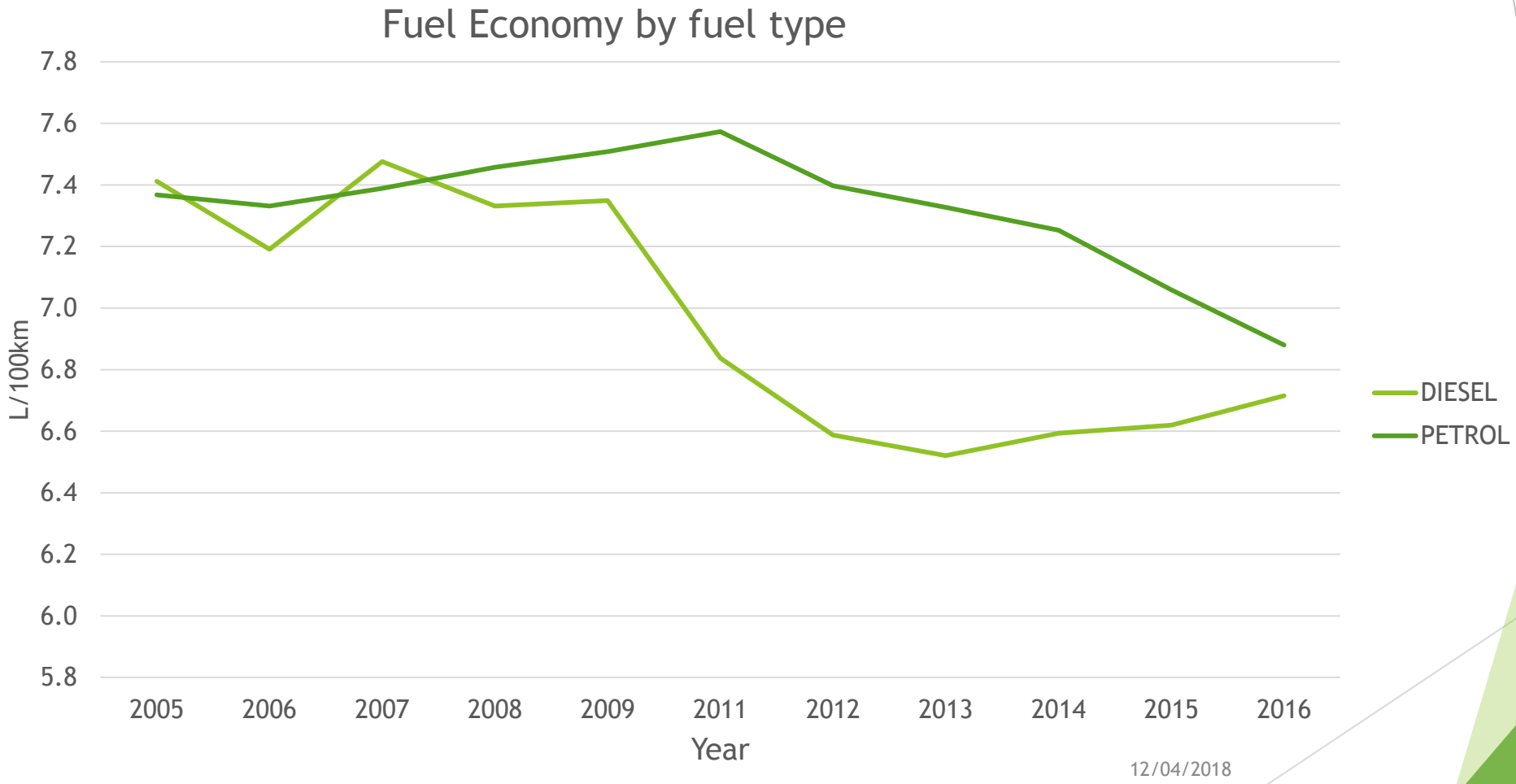

Fuel Economy
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
6.6
L/100km
6.9
7.4
NEW
USED
Condition


Fuel Economy of New and Used LDVs
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
L/100km
2005
2006
2007
2008
2009
2011
2012
2013
2014
2015
2016
Year
NEW
USED


Fuel Economy of newer and older LDVs
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
L/100KM
2005
2006
2007
2008
2009
2011
2012
2013
2014
2015
2016
YEAR
12/04/2018
<=5years
>5years


Fuel Economy of Used LDVs
>5years
<=5years
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
L/100km
2005
2006
2007
2008
2009
2011
2012
2013
2014
2015
2016
Year

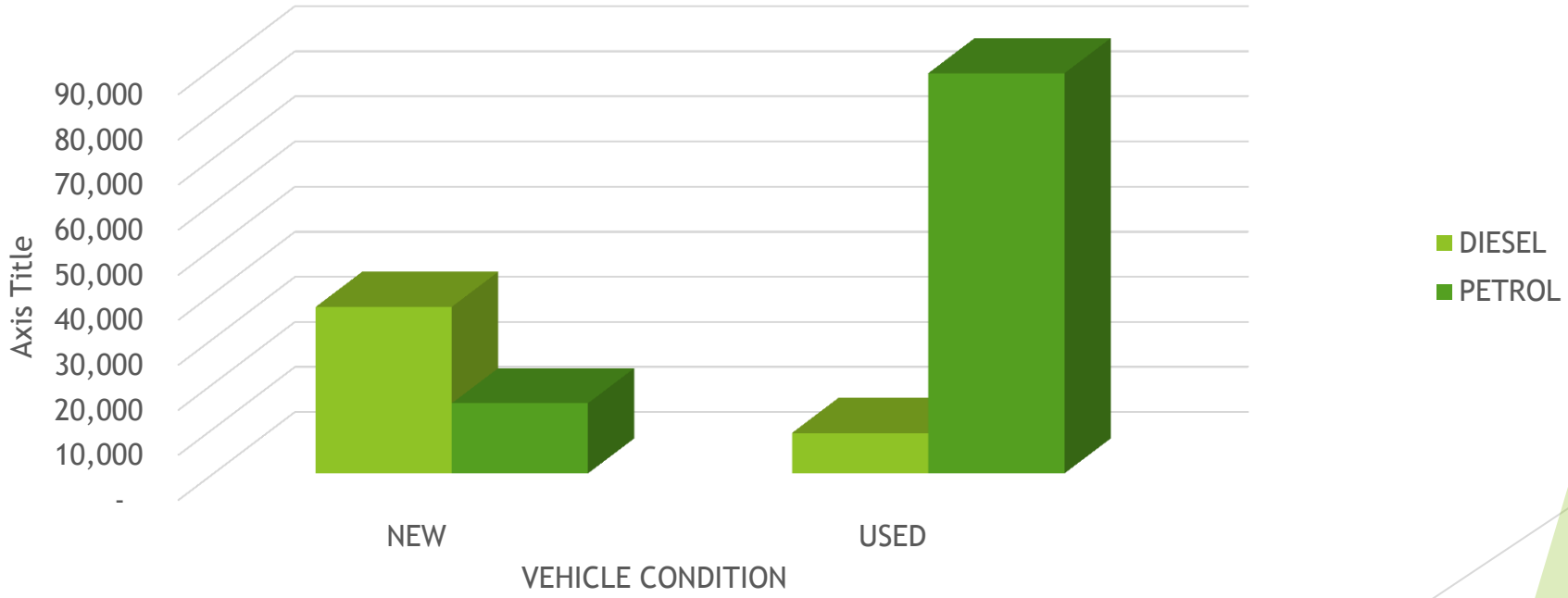

AV. FUEL ECONOMY BY FUEL TYPE
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
L/100km
7.0
7.3
DIESEL
PETROL
Fuel Type


Fuel Economy by fuel type
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
L/100km
2005
2006
2007
2008
2009
2011
2012
2013
2014
2015
2016
Year
DIESEL
PETROL

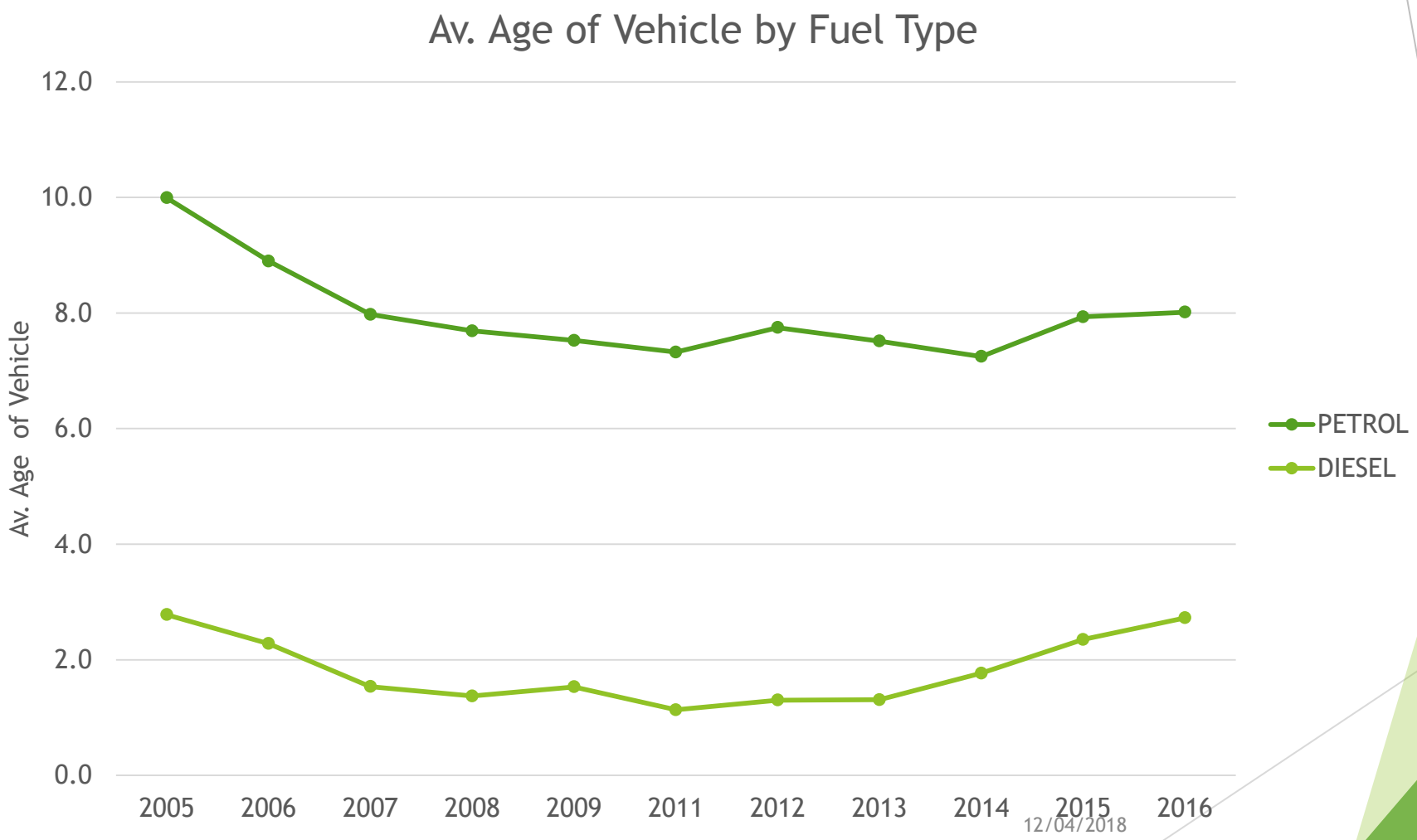
LDV Population Distribution by fuel type and condition

Row Labels	DIESEL	PETROL	Grand Total
NEW	36,999	15,584	52,583
USED	9,003	88,778	97,781
Grand Total	46,002	104,362	150,364

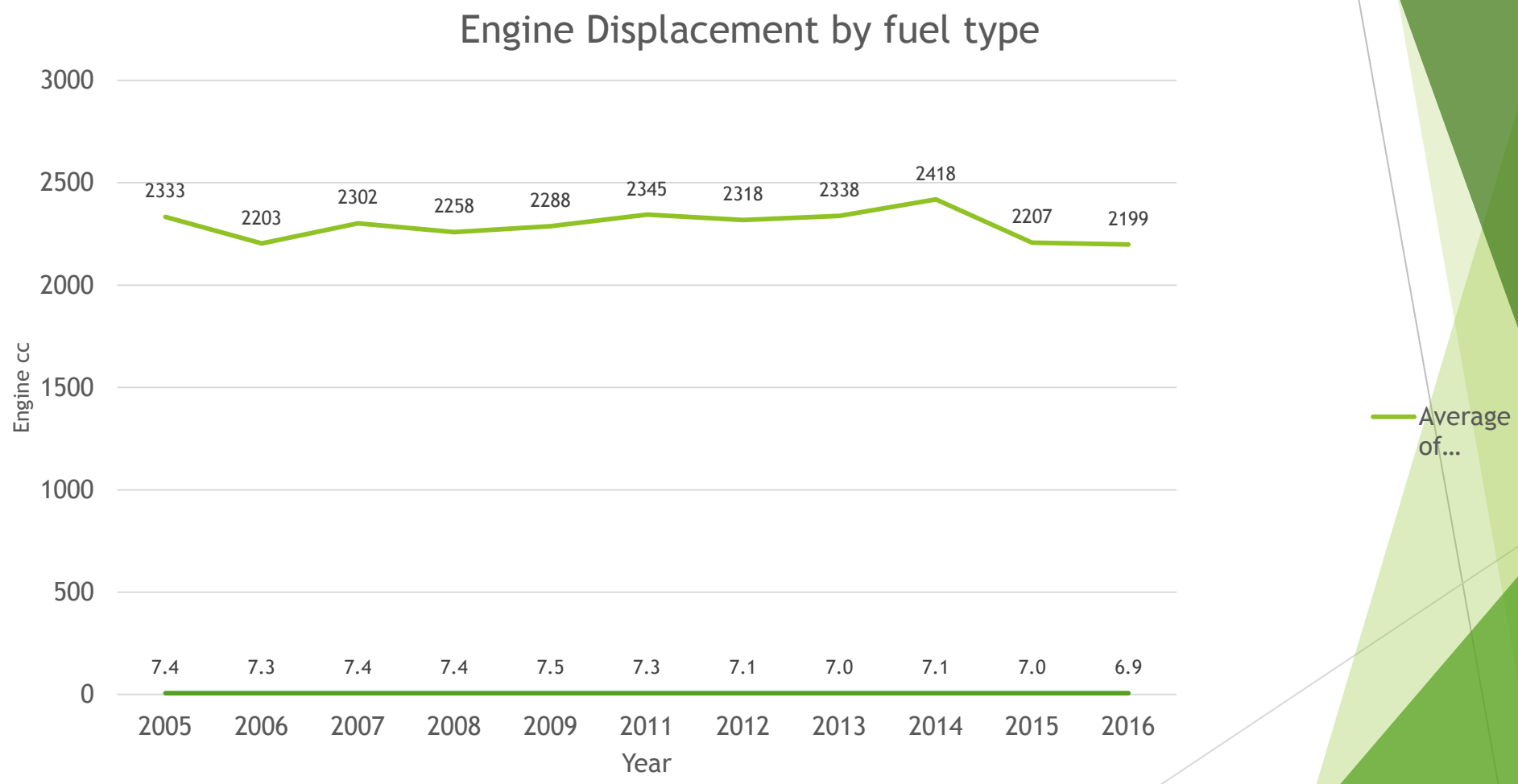
DISTRIBUTION OF VEHICLE BY FUEL TYPE AND CONDITION



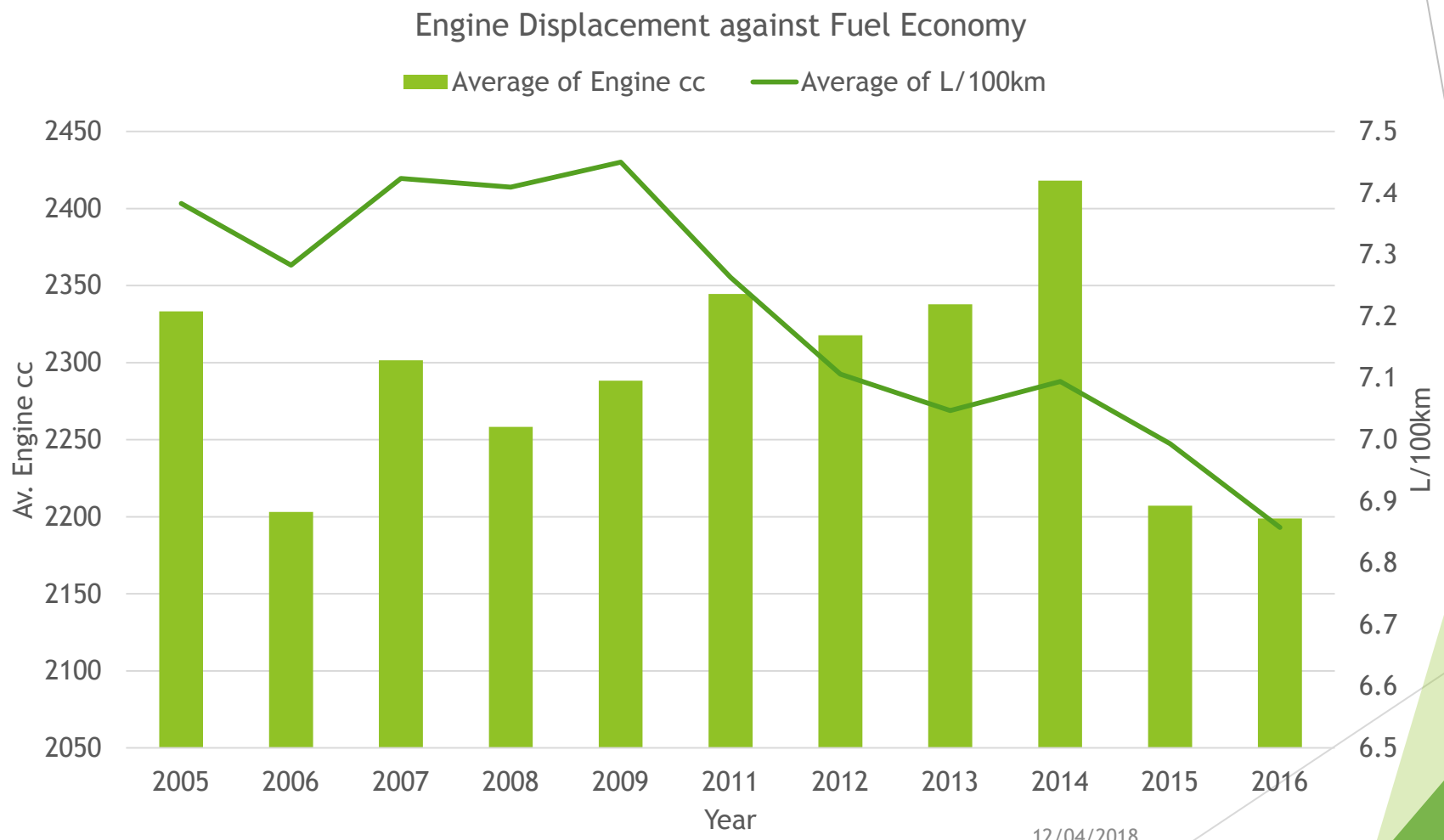
Average Age of Vehicle by fuel type			
Year	DIESEL	PETROL	Grand Total
2005	2.8	7.2	5.7
2006	2.3	6.6	5.1
2007	1.5	6.4	4.5
2008	1.4	6.3	4.4
2009	1.5	6.0	4.4
2011	1.1	6.2	4.1
2012	1.3	6.4	4.6
2013	1.3	6.2	4.5
2014	1.8	5.5	4.6
2015	2.3	5.6	5.1
2016	2.7	5.3	5.0
Grand Total	1.7	6.1	4.7

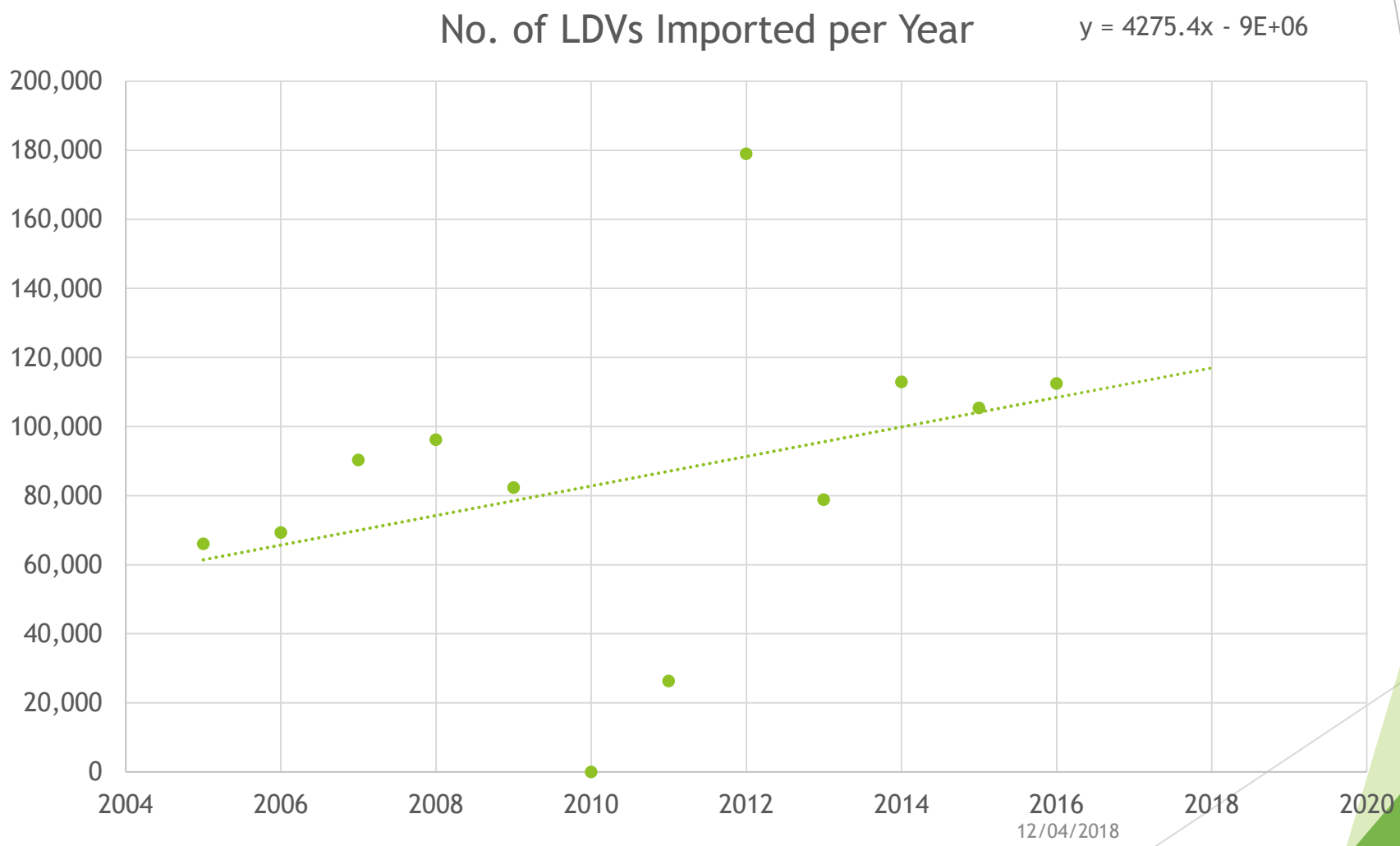

Av. Age of Vehicle by Fuel Type
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Av. Age of Vehicle
2005
2006
2007
2008
2009
2011
2012
2013
2014
2015
2016
PETROL
DIESEL

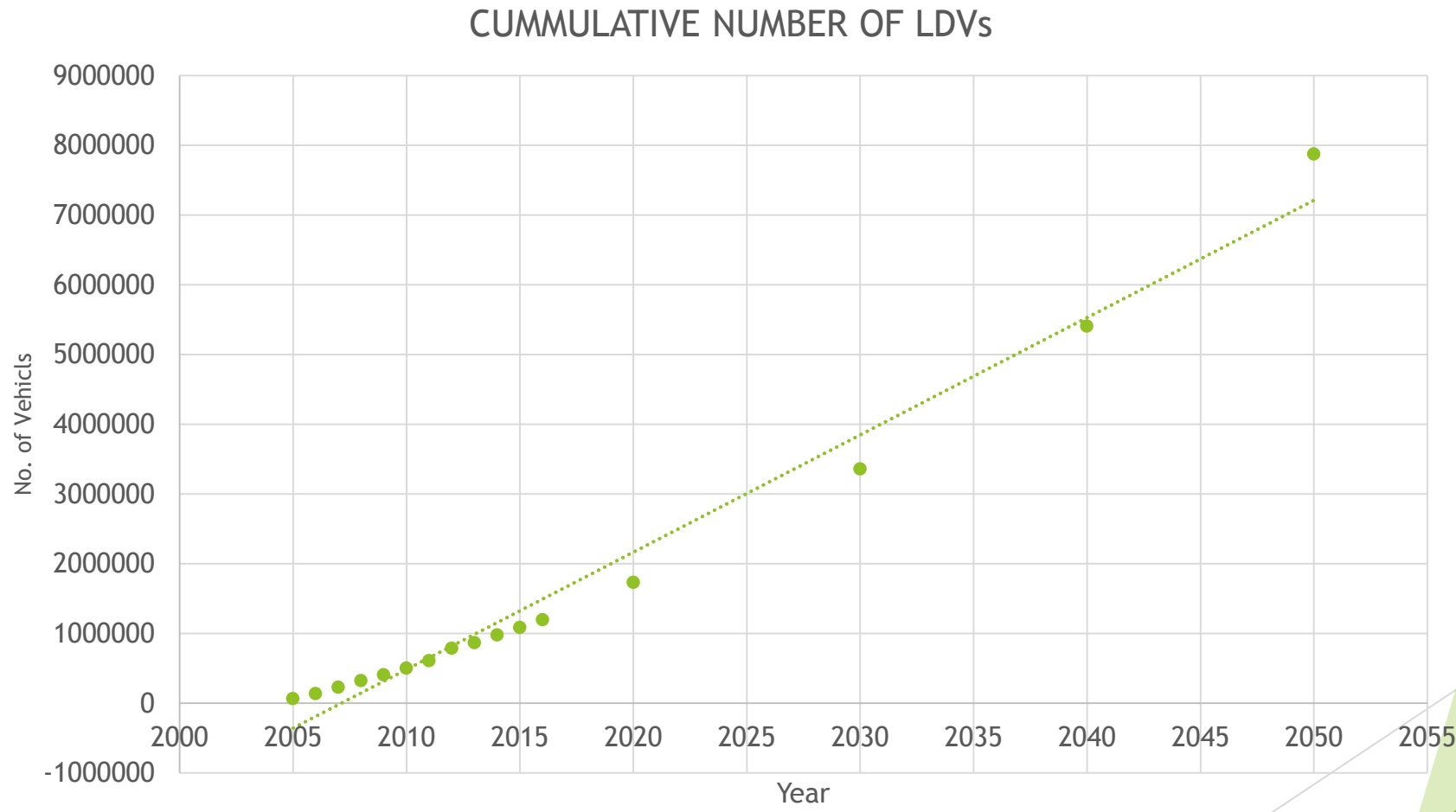
	DIESEL			PETROL		
Row Labels	NEW	USED	TOTAL	NEW	USED	TOTAL
2005	67%	33%	3,770	10.6%	89.4%	7,014
2006	74%	26%	4,034	17.1%	82.9%	7,618
2007	82%	18%	6,017	18.0%	82.0%	8,932
2008	85%	15%	5,594	16.4%	83.6%	9,202
2009	84%	16%	5,256	19.8%	80.2%	9,285
2011	90%	10%	1,649	15.6%	84.4%	2,262
2012	85%	15%	7,938	13.6%	86.4%	14,166
2013	87%	13%	3,711	14.1%	85.9%	6,988
2014	82%	18%	3,428	19.9%	80.1%	10,829
2015	72%	28%	2,332	10.4%	89.6%	13,207
2016	66%	34%	2,273	12.1%	87.9%	14,859
Grand Total	80%	20%	46,002	14.9%	85.1%	104,362


Engine Displacement by fuel type
3000
2500
2000
1500
1000
500
0
Engine cc
2333
2203
2302
2258
2288
2345
2318
2338
2418
2207
2199
7.4
7.3
7.4
7.4
7.5
7.3
7.1
7.0
7.1
7.0
6.9
2005
2006
2007
2008
2009
2011
2012
2013
2014
2015
2016
Year
Average of...

Year	Average Engine cc	Average L/100km
2005	2333	7.4
2006	2203	7.3
2007	2302	7.4
2008	2258	7.4
2009	2288	7.5
2011	2345	7.3
2012	2318	7.1
2013	2338	7.0
2014	2418	7.1
2015	2207	7.0
2016	2199	6.9
Grand Total	2286	7.2


Engine Displacement against Fuel Economy
Average of Engine cc
Average of L/100km
2450
2400
2350
2300
2250
2200
2150
2100
2050
Av. Engine cc
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
6.6
6.5
L/100km
2005
2006
2007
2008
2009
2011
2012
2013
2014
2015
2016
Year


No. of LDVs Imported per Year
y = 4275.4x - 9E+06
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2004
2006
2008
2010
2012
2014
2016
2018
2020


CUMMULATIVE NUMBER OF LDVs
No. of Vehicls
Year
9000000
8000000
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
-1000000
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055

YEAR	CUMULATIVE NO. OF LDVs
2005	66,036
2006	135,352
2007	225,664
2008	321,792
2009	404,093
2010	502,714
2011	607,270
2012	786,218
2013	865,053
2014	977,974
2015	1,083,340
2016	1,195,764
2020	1,728,885
2030	3,355,979
2040	5,403,490
2050	7,871,418

CONCLUSION

Ghana imported more petrol fuelled LDVs (104,362) than diesel fuel LDVs (46,002) in 2005 to 2016

The fuel economy of LDVs have been reducing over the years

Only 15% of imported petrol fuelled LDVs are new while 80% of imported diesel fuelled LDVs are new

The fuel economy of new LDVs imported into Ghana from 2005 to 2016 have lower fuel (6.9) than used LDVs (7.4)

The fuel economy of used LDVs less than 5 years is lower than used LDVs greater than 5 years old

Diesel fuelled LDVs have lower fuel economy(7.0) than petrol fuelled LDVs (7.3)


THANK
YOU!