Supplementary file for:

Providing a foundation for road transport energy demand analysis: A vehicle parc model for South Africa

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Vintage profile

This was defined by a Weibull cumulative distribution function as shown below:

If: x = age of the vehicle

$f(x)$ = the probability of the vehicle remaining operational (called the scrapping factor)

α = a constant

β = a constant

$$f(x) = e^{-\left(\frac{x}{\beta}\right)^{\alpha}} \quad \text{...(Equation 1)}$$

In order to approximate the vehicle stock in a future year, the total sales of a vehicle type in a particular year (vintage) are multiplied by the appropriate scrapping factor on the curve as shown below in Equation 2.

If: Y_S = The year of sale

Y_P = The year for which the vehicle park is being characterized

V_P = The stock of vehicles in the vehicle parc in year Y_P sold in year Y_S

V_S = The number of vehicles sold in year Y_S

$f(Y_P - Y_S)$ = The function estimating the probability of the vehicle remaining operational

$$V_P = f(Y_P - Y_S)\, V_S \quad \text{...(Equation 2)}$$

By substituting the result of Equation 1 in Equation 2, historical sales data can be converted to an approximation of stock for a given year. The constants for Equation 1 and the resulting average age of vehicle typologies in the model for the 2014 calibration year are presented below including data from previous studies for comparison.

Table 1 Passenger Vehicle Typology Weibull coefficients & resulting average ages for the calibrated model compared to other studies a sources

Source	Updated model			Phase 1			SA national octane study Bell et al (2003)			Moodley & Allopi (2008)
Year	**2014**			**2010**			**2002**			**2005**
Vehicle category	**β**	**α**	**Avg. Age**	**β**	**α**	**Avg. Age**	**β**	**α**	**Avg. Age**	**Avg. Age**
CarDiesel	23	3.0	6.0	22	3.0	5.0	20.2	3.2	4.2	10.0
CarGasoline	24	2.7	10.5	23	2.0	11.8	20.2	3.2	10.4	
CarHybridDiesel	22	3.0	0.3							
CarHybridGasoline	22	3.0	3.0	22	3.0	2.2				
CarElectic	20	3.0	0.7							
BusDiesel	30	3.5	12.5	30	3.0	15.4				11.0
MBTDiesel*	23.4	3.0	3.3	23	3.0	3.5				13.0
MBTGasoline*	23.4	3.0	13.0	23	3.0	13.0	20.0	3.2	11.3	
SUVDiesel	23	3.0	4.6	22	3.0	5.2				
SUVGasoline	23	3.0	5.4	22	3.0	6.9				
SUVHybridGasoline	22	3.0	3.5	22	3.0	0.7				
MotoGasoline	22	3.0	7.5	16	3.0	5.5				
	** MBT: Minibus Taxi*									

Table 2 Freight Vehicle Typology Weibull coefficients & resulting average ages for the calibrated model compared to other studies a sources

Source	Updated model			Phase 1			SA national octane study (Bell et al, 2003)			Stone & Bennett (2001)
Year	**2014**			**2010**			**2002**			**2000**
Vehicle category	**β**	**α**	**Avg. Age**	**β**	**α**	**Avg. Age**	**β**	**α**	**Avg. Age**	**Avg. Age**
LCVDiesel	23	4	7.9	22	3.0	7.8	20.2	3.2	7.2	9.3
LCVGasoline	23	3	11.6	22	1.4	12.4	20.2	3.2	9.9	
HCV1Gasoline	23	4	20.2	24	3.0	19.1				11.9
HCV1Diesel	23	3	8.7	24	3.0	8.5				
HCV2Diesel	23	3	9.1	24	3.0	9.6				
HCV3Diesel	23	2	9.0							
HCV4Diesel	23	3	9.3							

HCV5Diesel	23	3	9.1							
HCV6Diesel	23	3	7.5							
HCV7Diesel	23	2	7.8							
HCV8Diesel	23	2	4.6							
HCV9Diesel	23	2	8.3							

Vehicle mileage

As mentioned in the main body, the annual mileage of vehicles, when averaged over a large number, has been observed to decay steadily from an initial value for each year of operation (Jackson, 2001) (University of California at Riverside, 2002). However, the mileage data from the South African license renewal process and was not available. Hence, the mileage assumptions based on the US EPA’s Mobile6 model methodology (Jackson, 2001) were therefore adopted and scaled in the calibration process.

A curve of mileage versus age was generated by assuming a 4.9% annual rate of mileage decay from an initial ‘new vehicle’ value for all light vehicles while a steeper decay of 8.2% was assumed for the long haul-freight typologies HCV6Diesel – HCV9Diesel. Initial mileage values for commercial vehicles were adapted from the Road Freight Association’s (RFA) Vehicle Cost Schedule (Road Freight Association, 2009). The assumptions for new vehicle mileage and the calculated average mileage for the model vehicle typologies are shown in Table 11 and Table 12 compared to local and international data.

Table 3 Assumed average Passenger vehicle mileage (km/annum)

Region	**South Africa**							**North America**	**OECD – Europe & Pacific**	**non-OECD**
Source	**This model – new vehicle mileage**	**This model – average mileage of stock**	**Phase 1[1]**	**SAPIA PDSA[2]**	**RTMC[3]**	**LTMS[4]**	**Stone - Coastal KZN[6]**	**IEA/SMP Model (2010)[7]**		
Year	**2014**	**2014**	**2006**	**2008**	**2007**	**2003**	**2002**	**2010**	**2010**	**2010**
CarDiesel	21 000	16 748	21 254	19 000	14 644	15 000	18 873	17 600	11 250	10 875
CarGasoline	21 000	14 457	16 169	19 000		14 575	14 016	17 600	11 250	10 875
CarHybridDiesel	21 000	20 726								
CarHybridGasoline	21 000	18 715	23 678							
CarElectric	21 000	20 417								
BusDiesel	40 000	26 136	22 072		35 227	28 912	61 985	60 000	60 000	40 000
MBTDiesel	40 000	35 371	43 474		27 480	70 000		35 000	35 000	40 000
MBTGasoline	40 000	25 243	30 927	30 000		70 000	70 332	35 000	35 000	40 000
SUVDiesel	24 000	20 209	20 314							
SUVGasoline	24 000	19 646	19 128							
SUVHybridGasoline	24 000	20 899	24 000							
MotoGasoline	10 000	7 610	8 340		6 124			5 000	7 500	7 500

1:(Merven et al, 2012)
2:(NAAMSA / SAPIA Working Group, 2009)
3: (Road Traffic Management Corporation, 2009)
4: (DEAT, 2007)
5: (Bell, Stone, & Harmse, 2003) – This model used the speed dependent COPERT equations to calculate fuel economy so the calibration with fuel sales required adjustment of annual mileage if average speed was changed.
6:(Stone, 2004)
7: (IEA, 2011)

Table 4 Assumed average Freight vehicle mileage (km/annum)

Region	South Africa								North America	OECD – Europe & Pacific	non-OECD
Source	**This model – new vehicle mileage**	**This model – average mileage of stock**	**Phase 1[1]**	**Fleet Watch Online[2]**	**SAPIA PDSA[3]**	**RTMC[4]**	**LTMS[5]**	**Stone - Coastal KZN[6]**	**IEA/SMP Model (2010)[7]**		
Year	**2013**	**2013**	**2006**	**2006**	**2008**	**2007**	**2003**	**2002**	**2010**	**2010**	**2010**
LCVDiesel	30 800	20 397	19 202	35 000	19 500	18 806	15 000	20 577			
LCVGasoline	28 000	18 417	16 662	28 000	19 500		14 575	16 552			
HCV1Gasoline	50 000	10 311	13 575	50 000				38 229	32 000	25 000	21 125
HCV1Diesel	55 000	37 517	33 417	50 000				34 221	32 000	25 000	21 125
HCV2Diesel	55 000	27 195		65 000							
HCV3Diesel	77 000	51 398		85 000							
HCV4Diesel	93 500	60 800		85 000		42 901					
HCV5Diesel	106 700	62 461		110 000				71 354			
HCV6Diesel	111 100	69 225	48 403	110 000					60 000	60 000	50 000
HCV7Diesel	111 100	67 875		160 000							
HCV8Diesel	111 100	82 501		160 000							
HCV9Diesel	111 100	62 214		200 000							

1: (Merven et. Al, 2012)
2:(Fleet Watch Online, 2006)
3: (NAAMSA / SAPIA Working Group, 2009)
4: (Road Traffic Management Corporation, 2009)
5: (DEAT, 2007)
6:(Stone, 2004)
7: (IEA, 2011)

Fuel economy

The so-called 'type approval' measurement of fuel economy which becomes the official manufacturer's advertised fuel economy is determined in a laboratory using a specific test cycle[1]. These values have been demonstrated to not only underestimate real world fuel economy but, over time, have increasingly diverged from real world fuel economy as shown in Figure 10 below.

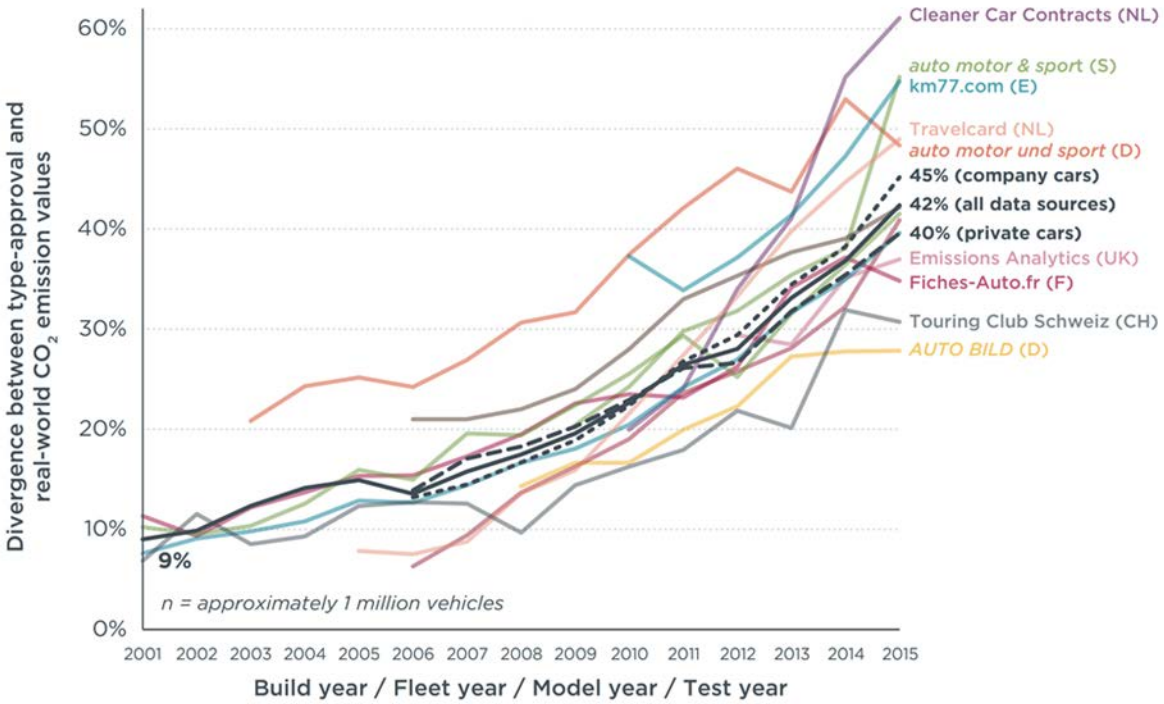

Figure 1: Increasing divergence of Real-world and test Cycle CO_2 emissions (proxy for fuel economy) for Europe (ICCT, 2016)

The South African vehicle parc is dominated by European and Japanese models[2] and it can be assumed that the divergence between the manufacturer's advertised fuel economy and real world consumption observed in the EU will be strongly evident. Table 13 below contrasts the observed trend in the fleet average of new passenger car fuel economy for the EU, Japan and South Africa. The South African values have been adjusted using Figure 10. As noted by the ICCT (ICCT, 2016), the real world new passenger car fleet fuel economy in the EU appears to have been static since 2010 despite manufacturer's advertised fuel economy dropping sharply. On average, advertised fuel economy decreased by 2.4% per annum between 2000 and 2015 in the EU but this rate drops to around 0.6% per annum after correction for divergence. Similarly, advertised fuel economy dropped by 1.6% per annum between 2005 and 2013 in South Africa but this rate drops to around 0.6% per annum after correction for divergence, if it is assumed that the South African market lags the EU market technologically by 5

[1] For South Africa this is the New European Drive Cycle (NEDC) which is the current standard in the EU but will be replaced by the Worldwide harmonized Light vehicles Test Procedure (WLTP) from 2017 to 2020 (ICCT, 2016)

[2] BMW, VW and Toyota accounted for 47% of passenger car sales in April 2017 (http://www.naamsa.co.za/flash/market.html)

years. If the assumed lag is reduced to 3 years the annual decrease drops to 0.2% and to 0.1% for a 2 year lag.

Table 5 Estimated Improvements in new passenger car fuel economy in South Africa and Feeder markets 2000–2015

Year	EU28 - GFEI[1] [LGE/100 km][5]	EU28 - EEA[2] [LGE/100 km]	EU Real world / Type Approval Diverg-ence (ICCT[3])	EU28 Est. Real World[4] [LGE/100 km]	Japan - GFEI[1] [LGE/100 km]	South Africa - GFEI[1] [LGE/100 km]	Real world / Type Approval Diverg-ence (ICCT[3]) (5 years offset)	South Africa Est. Real World (LGE/100 km)
2000		7.2	8%	7.8				
2005	6.7	6.8	15%	7.8	6.3	7.2	8%	7.8
2008	6.4	6.4	17%	7.5	6.0	7.1	12%	8.0
2010	5.9	5.9	23%	7.2	5.8	7.0	15%	8.0
2011	5.7	5.7	26%	7.2	5.5	6.7	14%	7.6
2012	5.6	5.5	28%	7.1	5.1	6.5	16%	7.6
2013	5.2	5.3	33%	7.1	4.9	6.3	17%	7.4
2015		5.0	42%	7.2				
CAGR	-3.1%	-2.4%		-0.6%	-3.0%	-1.6%		-0.5%
Δ [LGE/100 km]	-1.5	-2.2		-0.7	-1.4	-0.8		-0.3

1: (GFEI, 2016) *– Manufacturer's 'type approval' values measured using the New European Driving Cycle (NEDC). Read from graphs in publication*
2: (EEA, 2016) *– From NEDC cycle for Conventional Petrol and Diesel Vehicles converted to LGE/100 km and combined proportional to sales. Calculation does not include Alternative Fueled Vehicles (AFVs) which are indicated to have been 0.1% of sales in 2000 and 2.8% of sales in 2015*
3: (ICCT, 2016) *– See Figure 10. The 'All Data Sources' line has been used*
4: The fuel economy data determined using the NEDC cycle have been corrected upwards by the observed divergence between test cycle results and real world consumption. In the case of South Africa the new vehicle market has been assumed to lag the EU by 5 years on average (although latest variants are available) so the divergence values assumed are offset back by 5 years.
5: LGE/100 km - Litres Gasoline Equivalent per 100 km

For implementation of the model it was assumed that the fuel economy of new vehicles decreased by 0.5% per annum between 2000 and 2014, a value broadly consistent with the more certain value observed for Europe over the period.

Local data for Diesel Commercial vehicle fuel economy improvement was not found for this study. Heavy duty vehicle fuel economy is neither measured nor reported in the European Union although policy steps are being initiated (European Commission, 2017). Some analysis suggests that heavy vehicle fuel economy has been largely stagnant in Europe since the 90s (Jackson, 2011) (Transport & Environment, 2015). Heavy duty fuel economy improvement in South Africa over the last 20 years has however likely been high because of the low penetration of turbo-charged and turbo-intercooled engines into the market at the start of the modelling window. In 1998 turbo-charged engines only powered 26% of the total truck fleet and 58% of the long-haul fleet while turbo-intercooled engines only powered 4.8% of the total truck fleet and 14.5% of the long-haul fleet (Stone & Bennett, 2001). Turbo-intercooling of direct injection diesel engines enabled brake specific fuel consumptions of below 200 grams/kWh, an improvement of some 15-20% over naturally aspirated engines (Heywood, 1988). It was assumed therefore that heavy-duty diesel fuel economy improvement was 1.5% per annum between 2000 and 2014, an assumption that improved calibration quality.

The adjusted new vehicle fuel economy assumptions and the resulting fuel economy of the parc for the calibrated model are compared to other local and international studies and models in Table 14 and Table 15 below.

Table 6 Calibrated model fuel economy (l/100km) by Passenger vehicle typology compared to other studies and sources – Part 1

Region	South Africa									North America	OECD – Europe & Pacific	non-OECD
Source	**This model – new vehicle fuel economy**	**This Model – average fuel economy of stock**	**Phase 1**	**Vander-schuren[1]**	**SAPIA PDSA[2]**	**LTMS[3]**	**National Octane Study Model – 45 km/h[4]**	**National Octane Study Model – 34 km/h[4]**	**Stone - Coastal KZN[5]**	**IEA/SMP Model (2010)[6]**		
Year	**2014**	**2014**	**2006**	**2010**	**2008**	**2003**	**2002**	**2002**	**2002**	**2010**	**2010**	**2010**
CarDiesel	7.4	8.1	7.7	8.2	6.3	7.7	5.9	6.7	6.8	9.5	7.4	9.1
CarGasoline	7.8	8.2	9.1	10.5	8.4	9.3	7.5	8.6	10.8	11.6	8.9	11.1
CarHybridDiesel	5.8	5.8										
CarHybridGasoline	6.0	6.1	6.4									
CarElectric	2.2	2.2										
BusDiesel	28.3	32.6	35.5	36.0		36.1			27.9	33.0	33.0	28.0
*MBTDiesel	12.7	13.3	11.8	10.5		11.2						
*MBTGasoline	13.7	14.4	15.1	11.4	14.4	12.7	15.4	15.4	16.0	18.0	18.0	16.0
SUVDiesel	10.8	11.5	12.0									
SUVGasoline	13.5	13.8	13.7									
SUVHybridGasoline	6.9	7.0	7.3									
MotoGasoline	4.9	5.1	5.4							4.5	3.5	2.3

1: (Vanderschuren, 2011)
2: (NAAMSA / SAPIA Working Group, 2009)
3: (DEA, 2007)
4 (Bell, et al., 2003)– This model used the speed dependent COPERT equations to calculate fuel economy so the calibration with fuel sales required adjustment of annual mileage if average speed was changed.
5: (Stone & Bennett, 2001)
6: (Stone, 2004)
7: (IEA, 2011)

Table 7 Calibrated model fuel economy (l/100km) by Freight vehicle typology compared to other studies and sources – Part 1

<table>
<tr><th>Region</th><th colspan="9">South Africa</th><th>North America</th><th>OECD – Europe & Pacific</th><th>non-OECD</th></tr>
<tr><th>Source</th><th>This model – new vehicle fuel economy[1]</th><th>This Model – average fuel economy of stock</th><th>Phase 1</th><th>SAPIA PDSA[3]</th><th>LTMS[4]</th><th>National Octane Study Model – 45 km/h[5]</th><th>National Octane Study Model – 34 km/h[5]</th><th>Stone & Bennett[6]</th><th>Stone - Coastal KZN[7]</th><th colspan="3">IEA/SMP Model (2010)[8]</th></tr>
<tr><th>Year</th><th>2014</th><th>2014</th><th>2006</th><th>2008</th><th>2003</th><th>2002</th><th>2002</th><th>1998</th><th>2002</th><th>2010</th><th>2010</th><th>2010</th></tr>
<tr><td>LCVDiesel</td><td>11.3</td><td>12.4</td><td>12.2</td><td>10.5</td><td>11.2</td><td>7.7</td><td>9.0</td><td>8.7</td><td>10.6</td><td></td><td></td><td></td></tr>
<tr><td>LCVGasoline</td><td>14.3</td><td>15.0</td><td>14.2</td><td>13.8</td><td>14.7</td><td>10.8</td><td>13.3</td><td></td><td>12.5</td><td></td><td></td><td></td></tr>
<tr><td>HCV1Gasoline</td><td>16.5</td><td>17.8</td><td>38.7</td><td></td><td></td><td></td><td></td><td></td><td>31.4</td><td></td><td></td><td></td></tr>
<tr><td>HCV1Diesel</td><td>15.6</td><td>17.3</td><td>30.0</td><td></td><td></td><td></td><td></td><td>17.4</td><td>17.2</td><td>25.6</td><td>23.7</td><td>28.0</td></tr>
<tr><td>HCV2Diesel</td><td>19.4</td><td>21.2</td><td rowspan="8">40.7</td><td></td><td></td><td></td><td></td><td rowspan="8">31.6</td><td rowspan="8">47.5</td><td rowspan="8">41.9</td><td rowspan="8">36.1</td><td rowspan="8">33.1</td></tr>
<tr><td>HCV3Diesel</td><td>22.2</td><td>24.6</td><td></td><td></td><td></td><td></td></tr>
<tr><td>HCV4Diesel</td><td>25.5</td><td>28.6</td><td></td><td></td><td></td><td></td></tr>
<tr><td>HCV5Diesel</td><td>28.3</td><td>31.2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>HCV6Diesel</td><td>41.7</td><td>44.9</td><td></td><td></td><td></td><td></td></tr>
<tr><td>HCV7Diesel</td><td>38.3</td><td>41.5</td><td></td><td></td><td></td><td></td></tr>
<tr><td>HCV8Diesel</td><td>40.0</td><td>42.0</td><td></td><td></td><td></td><td></td></tr>
<tr><td>HCV9Diesel</td><td>46.7</td><td>51.6</td><td></td><td></td><td></td><td></td></tr>
</table>

1: (COPERT, year) - This model used the speed dependent COPERT equations to calculate fuel economy so the calibration with fuel sales required adjustment of annual mileage if average speed was changed.
2: (Vanderschuren, 2011)
3: (NAAMSA / SAPIA Working Group, 2009)
4: (DEAT, 2007)
5: (Bell, Stone, & Harmse, 2003) – This model used the speed dependent COPERT equations to calculate fuel economy so the calibration with fuel sales required adjustment of annual mileage if average speed was changed.
6: (Stone & Bennett, 2001)
7: (Stone, 2004)
8: (IEA, 2011)

Occupancy and load factor

No published local empirical data was available to guide the assumptions for vehicle occupancy and load factor which are needed to calculate the demand for passenger.km and ton.km in the model.

Initial freight load factors were drawn from the Road Freight Association's Vehicle Cost Schedule (RFA, 2009) and then calibrated to the ton.km estimate for 2014 published by the Department of Logistics, University of Stellenbosch (Havenga, et al., 2016a). The Department of Logistics estimate road freight activity using two models, the Freight Demand Model (FDM) and the National Freight Flow Model (NFFM) which incorporate commodity flows and freight vehicle flows respectively (CSIR, 2012). The NFFM which is based on traffic counts tends to overestimate ton.km and the FDM, which is based on freight flows, tends to undercount. Their annual logistics report estimate of freight demand recently switched to the FDM model output with some correction upwards (using NFFM) to account for the model's inability to estimate local distribution trips. The resulting lower figure made calibration possible for this study after a revision of capacity factors and maximum loads for heavy truck typologies. A particularly important incorporation was reflecting the upward trend in capacity factor for very heavy articulated trucks in the dominant 57 ton GVM typology operating on corridors, which has reportedly reached 85% and continues to rise (Havenga & Simpson, 2016b).

A key feature of the updated and more disaggregate HCV representations was accounting for the prevalence of truck-tractors in the vehicle sales data and translating this to load capacities for each typology. The approach as shown below in Table 16, was to estimate the share of rigid and articulated trucks for each typology and respective payload capacities for each sub-typology so that a weighted average payload could be estimated. The HCV6 vehicle typology dominates the HCV parc and includes a high share of truck tractors. It was assumed that many of these truck tractors are coupled to trailers in the dominant 57 ton GVM articulated truck segment. By assuming a high share of articulated trucks for this typology and a high average load factor of 73% (includes old trucks not on corridors) it was possible to calibrate freight demand to the published ton.km figure, while still leaving enough diesel in the calibration for cars, SUVs and off-road applications.

Table 8: Detailed Payload Capacity and Configuration Assumptions for Freight Vehicle Typologies

SATIM Vehicle Typology	NAAMS A GVM Typology [tons][1]	Assumed Capacity Factors[2]	Assumed Avg. Payload Capacity--Rigid [tons]	Assumed Avg. Payload Capacity – Artic.[3] [tons]	Assumed Share of tons moved (Rigid)	Assumed Share of tons moved (Artic.)	Assumed Weight. Average Payload Capacity [tons]
HCV1Diesel	3-7.5	45%	3	0	100%	0%	3.3
HCV1Gasoline	3-7.5	45%	3	0	100%	0%	3.0
HCV2Diesel	7.5-12	50%	5	0	100%	0%	5.0
HCV3Diesel	12–16	55%	7	14	70%	30%	9.1
HCV4Diesel	16-20	60%	10	18	60%	40%	13.2
HCV5Diesel	20-24	65%	12	22	50%	50%	16.8
HCV6Diesel	24-32	78%	14	28	10%	90%	26.6
HCV7Diesel	32-40	76%	19	30	50%	50%	24.5
HCV8Diesel	40-50	73%	24	32	85%	15%	25.2
HCV9Diesel	>50	73%	30	34	100%	0%	30.0
LCVDiesel	<3	40%	1	0	100%	0%	1.0
LCVGasoline	<3	40%	1	0	100%	0%	1.0

1: Includes Truck-tractors, rigids, tippers etc. so GCM and payload capacity varies widely within these categories for larger GVM

2: Average Payload/Maximum Payload

3: Articulated truck – A combination of a truck-tractor and multi-wheel trailer

The final occupancy and load factors assumed for the model are compared to other studies and sources in

Table 17 and **Table 18** below. The higher payload capacities and capacity factors assumed for the updated model resulted in a load factor of 14.6 ton/vehicle for Heavy Commercial Vehicles (HCV2-HCV9), almost double that assumed in (Merven, et al., 2012).

Table 9 Model occupancy and load factor of Passenger vehicle typology compared to other studies and sources

Region		South Africa				North America	OECD – Europe & Pacific	non-OECD
Source		**Updated Model**	**Phase 1**	**Vander-schuren[1]**	**LTMS [2]**	**IEA/SMP Model[3]**		
Year	**Units**	**2014**	**2006**	**2010**	**2003**	**2010**	**2010**	**2010**
CarDiesel	pass/veh	1.4	1.4	1.40	2.10	1.47*	1.61*	1.77*
CarGasoline	pass/veh	1.4	1.4	1.40	2.10	1.47*	1.61*	1.77*
CarHybridDiesel	pass/veh	1.4	1.4					
CarHybridGasoline	pass/veh	1.4	1.4					
CarElectic	pass/veh	1.4	1.4					
BusDiesel	pass/veh	25	25	40	35	12.00	16.70	22.00
*MBTDiesel	pass/veh	14	14	12	35	6.00	8.40	10.70
*MBTGasoline	pass/veh	14	14	12	15	6.00	8.40	10.70
SUVDiesel	pass/veh	1.4	1.4					
SUVGasoline	pass/veh	1.4	1.4					
SUVHybridGasoline	ton/veh	1.4	1.4					
MotoGasoline	ton/veh	1.1	1.1			1.20	1.20	1.40

**Data for LDVs which include cars and light trucks/vans/SUVS*
1: (Vanderschuren, 2011)
2: (DEAT, 2007)
3: (IEA, 2011)

Table 10 Model occupancy and load factor of Freight vehicle typology compared to other studies and sources

Region		South Africa			North America	OECD – Europe & Pacific	non-OECD
Source		**Updated Model**	**Phase 1[3]**	**LTMS[1]**	**IEA/SMP Model[2]**		
Year	**Units**	**2014**	**2006**	**2003**	**2010**	**2010**	**2010**
LCVDiesel	ton/veh	0.4	0.25	2.1			
LCVGasoline	ton/veh	0.4	0.25	2.1			
HCV1Gasoline	ton/veh	1.5	1.25		2.2	1.6	1.7
HCV1Diesel	ton/veh	1.4	1.25		2.2	1.6	1.7
HCV2Diesel	ton/veh	2.5	7.5		10.0	8.0	6.3
HCV3Diesel	ton/veh	5.0					
HCV4Diesel	ton/veh	7.9					
HCV5Diesel	ton/veh	10.9					
HCV6Diesel	ton/veh	20.7					
HCV7Diesel	ton/veh	18.6					
HCV8Diesel	ton/veh	18.4					
HCV9Diesel	ton/veh	21.9					

**Data for LDVs which include cars and light trucks/vans/SUVS*
1: (DEAT, 2007)
***2**: (IEA, 2011)*
***3**: These were calculated assuming a 50% capacity factor*