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The Initiative for Climate Action Transparency (ICAT), supported by Austria, Canada, Germany, Italy, the Children's Investment Fund Foundation and the ClimateWorks Foundation.

The ICAT Secretariat is managed and supported by the United Nations Office for Project Services (UNOPS)

ENERGY

1.A.3.b – ROAD TRANSPORT

The primary modes of road transport in Vanuatu consist of cars, minibuses, trucks, and motorcycles. These forms of transport are predominantly found in urbanized areas such as Port Vila on Efate and Luganville on Santo. In contrast, some islands have limited transportation options due to the lack of paved roads.

According to the Intergovernmental Panel on Climate Change (IPCC), the vehicles that will be evaluated using the Tier 1 method include cars, light-duty vehicles, buses, motorcycles, and heavy-duty vehicles.

As urbanization progresses over the years, there has been a corresponding increase in vehicle ownership among the population. This trend is clearly illustrated in Table 1 and in Figure 1, which shows an estimated annual increase of 841 vehicles. The growth in population leads to the expansion of settlements into rural areas of Port Vila and Santo. Consequently, the need for personal transportation rises, further contributing to the increase in the number of vehicles.

Table 1: Total Annual Number of Vehicles: 2000 - 2023

ANNUAL NUMBER OF VEHICLES						TOTAL NUMBER OF VEHICLES
YEAR	Motorcars (Auto)	Pick-Ups (Camionettes)	Trucks (Camions)	Buses (Autobus, Minibus)	Motor-cycle (Motocuclettes)	
2000	164	150	50	99	18	481
2001	279	256	83	134	37	789
2002	415	358	98	162	57	1090
2003	546	504	125	202	73	1450
2004	721	662	144	227	94	1848
2005	972	839	190	305	114	2420.2113
2006	1257	1030	244	395	136	3062.1322
2007	1577	1235	305	497	160	3773.7627
2008	1932	1454	373	612	185	4555.1028
2009	2321	1687	449	738	212	5406.1525
2010	2744	1934	532	738	240	6187.8788
2011	3202	2194	622	1029	270	7317.3807
2012	3695	2469	720	1192	301	8377.5592
2013	4223	2757	826	1368	334	9507.4473
2014	4785	3060	939	1556	368	10707.045
2015	5217	3226	1009	1657	386	11495.3523
2016	5733	3450	1103	1835	405	12526.3692
2017	6206	3743	1249	1249	424	12871.639
2018	6823	4024	1406	2460	454	15167.3692

2019	7406	4133	1491	2509	475	16014.3692
2020	7771	4164	1511	2490	468	16404.1579
2021	8173	4240	1552	2475	461	16901.237
2022	8055	4091	1513	2385	443	16487.6065
2023	8949	4270	1668	2509	457	17853.2664

Figure 1: Energy Sector: Annual Total Number of Vehicles on the road: 2000 - 2023

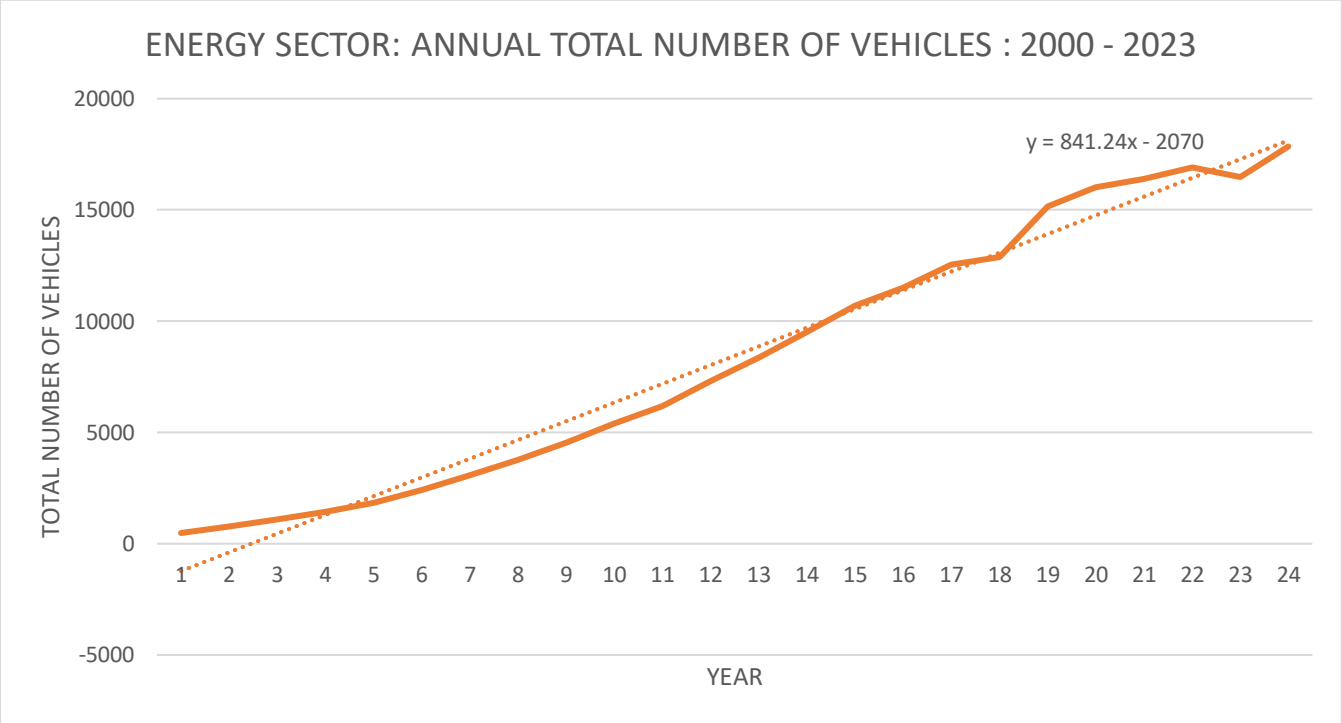


Figure 1: Illustrates an estimated annual increase in the number of vehicles at a rate of 841 vehicles per year. This rise in vehicle numbers is associated with population growth and urbanization, as more individuals commute to urban areas, thereby necessitating the use of vehicles.

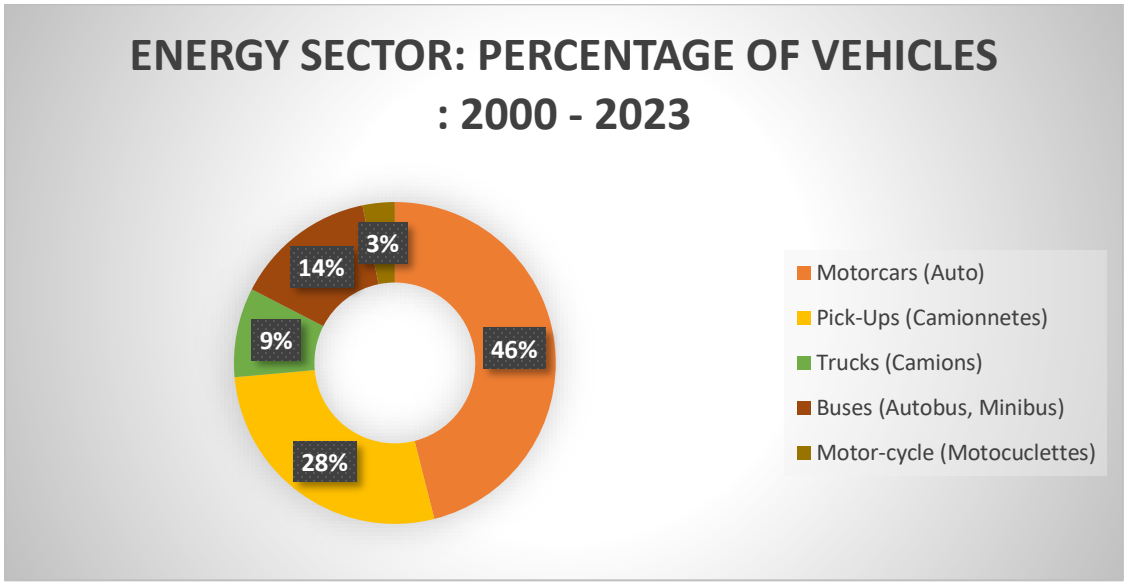
The most common vehicle in Vanuatu from 2000 to 2023 is the motorcar, accounting for 46% of all vehicles and increasing by 410 cars annually. The second most popular vehicle is the light-duty truck, which makes up 28% of registered vehicles and grows at a rate of 207 trucks per year. Buses rank third, representing 14% of the total, with an annual increase of 122 minibuses, which serve as a vital transport option and side business for many residents.

The second least common vehicle type in Vanuatu is heavy-duty trucks, or camions, which represent 9% of the total truck population from 2000 to 2023. These vehicles are primarily owned by commercial businesses for specific delivery and operational needs, resulting in their

lower numbers. According to Figure 3, the growth rate for these trucks is approximately 78 trucks per year.

The least common vehicle type is motorcycles, which account for only 3% of vehicles in Vanuatu. Their limited use is attributed to poor road conditions and personal preferences among the population. Motorcycles are increasing at a rate of just 22 vehicles per year.

Figure 2: Energy Sector: Percentage of Each Vehicle Type in Vanuatu.



The data indicates that Motorcars are the most popular vehicle type in Vanuatu, followed by Camionettes (light-duty trucks), Buses, Trucks, and Motorcycles.

Figure 3: Energy Sector Annual Number of Vehicles on the Road: 2000 - 2023

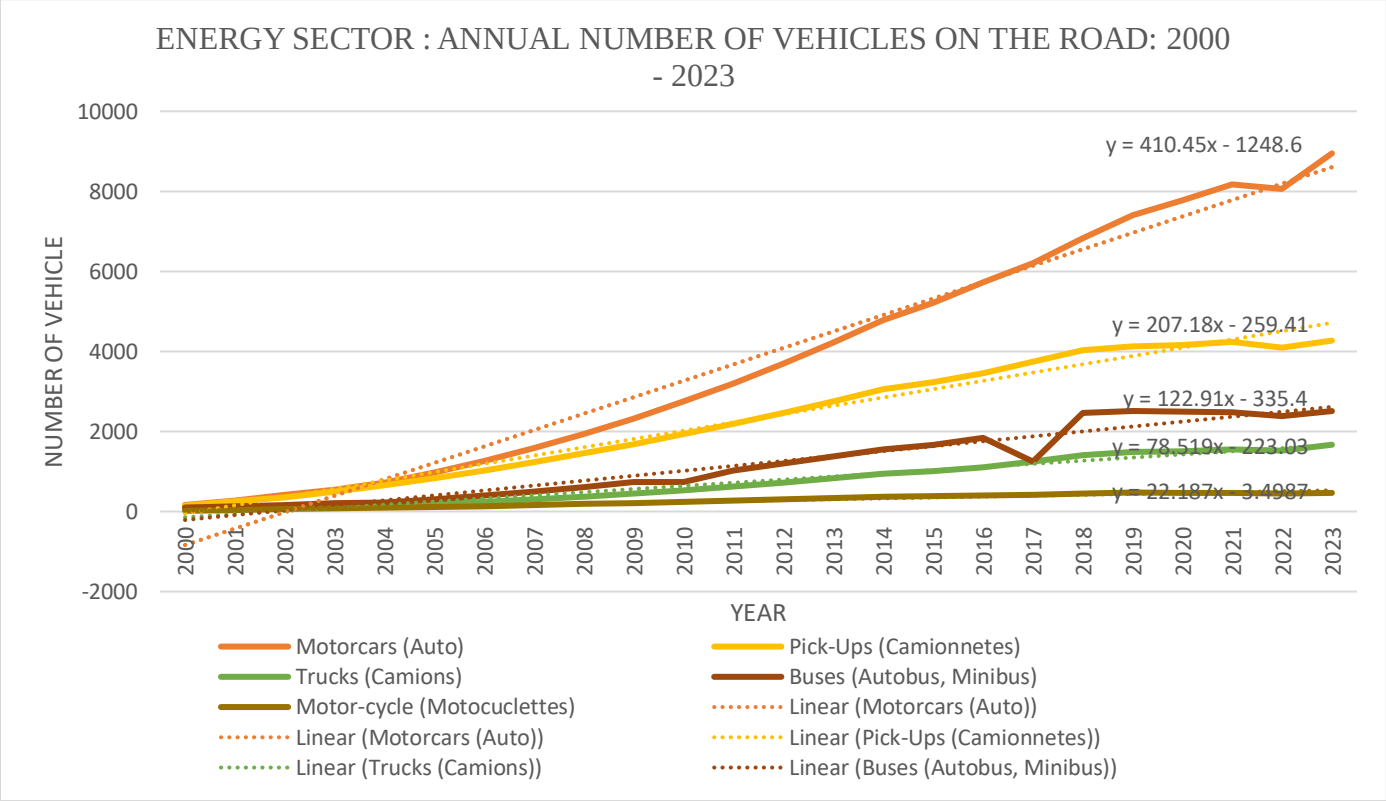


Figure 3 illustrates the annual growth rates of various vehicles. Motorcars lead with an increase of 410 cars per year, followed by camionettes (light-duty trucks) at 207 vehicles per year. Buses rank third, growing at a rate of 122 vehicles annually. The least common vehicles are heavy-duty trucks (camions) and motorcycles, increasing at rates of 78 and 22 vehicles per year, respectively.

Carbon dioxide (CO_2) is one of the most common gases emitted by road vehicles, as illustrated in Figure 4. The combustion of gasoline and diesel fuels in internal combustion engines generates CO_2 and water vapor, releasing these emissions into the atmosphere. The volume of CO_2 emitted is directly proportional to the amount of fuel consumed by the vehicle.

Heavy-duty trucks are the largest contributors to CO_2 emissions, accounting for 65% of total emissions due to their size and weight. Buses, used for longer distances, also contribute significantly to emissions alongside heavy-duty trucks. In contrast, cars have smaller engines and are primarily used for shorter commutes, making them the second highest emitters of CO_2 due to their prevalence on the roads. Light-duty trucks contribute 15% of CO_2 emissions; they are lighter than heavy-duty trucks and travel shorter distances compared to buses, resulting in lower

overall emissions. Motorcycles contribute negligibly to emissions, accounting for nearly 0% due to their lighter weight and lower popularity as road vehicles. Table 2 presents the estimated CO_2(g) emissions from the road transport sector.

Table 2.1: Energy Sector Road Transport Gg CO_2(g) Emissions: 2000 - 2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cars Emissions Gg CO2(g)	0.224447	0.381834	0.567961	0.747245	0.986746	1.329949	1.720471	2.15831	2.64347	3.175948	3.755744
light duty Trucks and Buses Emissions Gg CO2(g)	0.513206	0.67988	0.840264	1.069834	1.318273	1.596796	1.897199	2.21948	2.563645	2.929688	3.317611
Heavy Trucks and Buses Emissions Gg CO2(g)	1.354935	1.956949	2.347055	2.94907	3.342386	5.381314	5.7592	7.23368	8.885541	10.71478	11.38221
Motorcycle Emissions Gg CO2(g)	0.006935	0.014256	0.021961	0.028126	0.036217	0.044064	0.052515	0.06157	0.071235	0.081503	0.092376
Total Gg CO2(g)	2.099523	3.032919	3.777241	4.794275	5.683622	8.352123	9.429386	11.673	14.16389	16.90192	18.54794

Table 2.2: Energy Sector Road Transport Gg CO_2(g) Emissions: 2011 - 2020

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cars Emissions Gg CO2(g)	4.382859	5.057293	5.779045	6.548116	7.140058	7.84638	8.493719	9.33813	10.13601	10.63586
light duty Trucks and Buses Emissions Gg CO2(g)	3.727414	4.159096	4.612659	5.088101	5.349564	5.702092	6.162804	6.60465	6.776039	6.824574
Heavy Trucks and Buses Emissions Gg CO2(g)	14.90541	17.2668	19.80557	22.52172	24.06032	26.52922	22.05925	34.9815	36.13577	36.11413
Motorcycle Emissions Gg CO2(g)	0.103855	0.115939	0.128629	0.141924	0.148889	0.156074	0.163395	0.17495	0.183045	0.180207
Total Gg CO2(g)	23.11954	26.59913	30.3259	34.29986	36.69883	40.23377	36.87917	51.0992	53.23087	53.75477

Table 2.3: Energy Sector Road Transport Gg CO_2(g) Emissions: 2021 – 2023

	2021	2022	2023
Cars Emissions Gg CO2(g)	11.18555	11.02416	12.24699
light duty Trucks and Buses Emissions Gg CO2(g)	6.944001	6.709772	6.991423
Heavy Trucks and Buses Emissions Gg CO2(g)	36.302	35.1197	37.55993
Motorcycle Emissions Gg CO2(g)	0.177535	0.170789	0.176153
Total Gg CO2(g)	54.60909	53.02442	56.9745

(Note: The arrangement of tables has been separated for space considerations.)

Nitrous oxide (N_2O) is a potent greenhouse gas (GHG) typically emitted in smaller quantities than carbon dioxide (CO_2), as shown in Figure 4. Despite its lower emission volume, N2O has a significantly high global warming potential (GWP), making it detrimental to the environment. Table 3 presents a summary of the nitrous oxide emissions generated by each category of vehicle.

Table 3.1: Energy Sector Road Vehicle Emissions Gg N_2O(g): 2000 - 2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cars Emissions Gg N2O(g)	9.12E-06	1.55E-05	2.31E-05	3.04E-05	4.01E-05	5.41E-05	6.99E-05	8.77E-05	1.07E-04	1.29E-04	1.53E-04
light duty Trucks and Buses Emissions Gg N2O(g)	3.40E-05	4.77E-05	6.09E-05	7.98E-05	1.00E-04	1.23E-04	1.48E-04	1.74E-04	2.03E-04	2.33E-04	2.65E-04
Heavy Trucks and Buses Emissions Gg N2O(g)	8.98E-05	1.30E-04	1.55E-04	1.95E-04	2.21E-04	3.56E-04	3.82E-04	4.79E-04	5.89E-04	7.10E-04	7.54E-04
Motorcycle Emissions Gg N2O(g)	4.59E-07	9.44E-07	1.45E-06	1.86E-06	2.40E-06	2.92E-06	3.48E-06	4.08E-06	4.72E-06	5.40E-06	6.12E-06
Total Gg N2O(g)	1.33E-04	1.94E-04	2.41E-04	3.07E-04	3.64E-04	5.37E-04	6.03E-04	7.45E-04	9.03E-04	1.08E-03	1.18E-03

Table 3.2: Energy Sector Road Vehicle Emissions Gg N_2O(g): 2011 - 2020

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cars Emissions Gg N2O(g)	1.78E-04	2.06E-04	2.35E-04	2.66E-04	2.90E-04	3.19E-04	3.45E-04	3.80E-04	4.12E-04	4.32E-04
light duty Trucks and Buses Emissions Gg N2O(g)	2.98E-04	3.34E-04	3.71E-04	4.10E-04	4.32E-04	4.61E-04	4.99E-04	5.35E-04	5.49E-04	5.53E-04
Heavy Trucks and Buses Emissions Gg N2O(g)	9.87E-04	1.14E-03	1.31E-03	1.49E-03	1.59E-03	1.76E-03	1.46E-03	2.32E-03	2.39E-03	2.39E-03
Motorcycle Emissions Gg N2O(g)	6.88E-06	7.68E-06	8.52E-06	9.40E-06	9.86E-06	1.03E-05	1.08E-05	1.16E-05	1.21E-05	1.19E-05
Total Gg N2O(g)	1.47E-03	1.69E-03	1.93E-03	2.18E-03	2.33E-03	2.55E-03	2.32E-03	3.24E-03	3.37E-03	3.39E-03

Table 3.3: Energy Sector Road Vehicle Emissions Gg N_2O(g): 2021 – 2023

	2021	2022	2023
Cars Emissions Gg N2O(g)	4.55E-04	4.48E-04	4.98E-04
light duty Trucks and Buses Emissions Gg N2O(g)	5.63E-04	5.44E-04	5.67E-04
Heavy Trucks and Buses Emissions Gg N2O(g)	2.40E-03	2.33E-03	2.49E-03
Motorcycle Emissions Gg N2O(g)	1.18E-05	1.13E-05	1.17E-05
Total Gg N2O(g)	3.43E-03	3.33E-03	3.56E-03

(Note: The arrangement of tables has been separated for space considerations.)

Methane (CH_4) is generally released at lower rates compared to CO_2 and N_2O. Its emissions primarily occur through incomplete combustion and evaporative losses from fuel systems. Although CH_4 is 25 times more effective than CO_2 over a century in terms of GWP, its overall contribution to road transport emissions remains minimal when compared to CO2, as illustrated in Figure 4. Table 4 presents estimated CH4(g) emissions from the road transport sector for the years 2000 to 2023.

Table 4.1: Energy Sector Road Vehicle Emissions Gg CH_4(g): 2000 - 2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cars Emissions Gg CH4(g)	1.20E-05	2.05E-05	3.05E-05	4.01E-05	5.29E-05	7.13E-05	9.23E-05	1.16E-04	1.42E-04	1.70E-04	2.01E-04
light duty Trucks and Buses Emissions Gg CH4(g)	2.75E-05	3.67E-05	4.55E-05	5.81E-05	7.17E-05	8.69E-05	1.03E-04	1.21E-04	1.40E-04	1.60E-04	1.81E-04
Heavy Trucks and Buses Emissions Gg CH4(g)	7.27E-05	1.05E-04	1.26E-04	1.58E-04	1.79E-04	2.89E-04	3.09E-04	3.88E-04	4.77E-04	5.75E-04	6.11E-04
Motorcycle Emissions Gg CH4(g)	3.72E-07	7.65E-07	1.18E-06	1.51E-06	1.94E-06	2.36E-06	2.82E-06	3.30E-06	3.82E-06	4.37E-06	4.96E-06
Total Gg CH4(g)	1.13E-04	1.63E-04	2.03E-04	2.58E-04	3.06E-04	4.49E-04	5.07E-04	6.28E-04	7.62E-04	9.10E-04	9.98E-04

Table 4.2: Energy Sector Road Vehicle Emissions Gg CH_4(g): 2011 – 2020

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cars Emissions Gg CH4(g)	2.35E-04	2.71E-04	3.10E-04	3.51E-04	3.83E-04	4.21E-04	4.56E-04	5.01E-04	5.44E-04	5.71E-04
light duty Trucks and Buses Emissions Gg CH4(g)	2.04E-04	2.27E-04	2.52E-04	2.78E-04	2.93E-04	3.12E-04	3.37E-04	3.62E-04	3.71E-04	3.74E-04
Heavy Trucks and Buses Emissions Gg CH4(g)	8.00E-04	9.26E-04	1.06E-03	1.21E-03	1.29E-03	1.42E-03	1.18E-03	1.88E-03	1.94E-03	1.94E-03
Motorcycle Emissions Gg CH4(g)	5.57E-06	6.22E-06	6.90E-06	7.61E-06	7.99E-06	8.37E-06	8.77E-06	9.39E-06	9.82E-06	9.67E-06
Total Gg CH4(g)	1.24E-03	1.43E-03	1.63E-03	1.85E-03	1.97E-03	2.16E-03	1.99E-03	2.75E-03	2.86E-03	2.89E-03

Table 4.3: Energy Sector Road Vehicle Emissions Gg CH_4(g): 2021 – 2023

	2021	2022	2023
Cars Emissions Gg CH4(g)	5.71E-04	6.00E-04	5.91E-04
light duty Trucks and Buses Emissions Gg CH4(g)	3.74E-04	3.80E-04	3.67E-04
Heavy Trucks and Buses Emissions Gg CH4(g)	1.94E-03	1.95E-03	1.88E-03
Motorcycle Emissions Gg CH4(g)	9.67E-06	9.52E-06	9.16E-06
Total Gg CH4(g)	2.89E-03	2.94E-03	2.85E-03

(Note: The arrangement of tables has been separated for space considerations.)

Figure 4: Energy Sector: Annual Emissions of Gg CO_2(g), CH_4(g) And N_2O(g) From Road Vehicles.

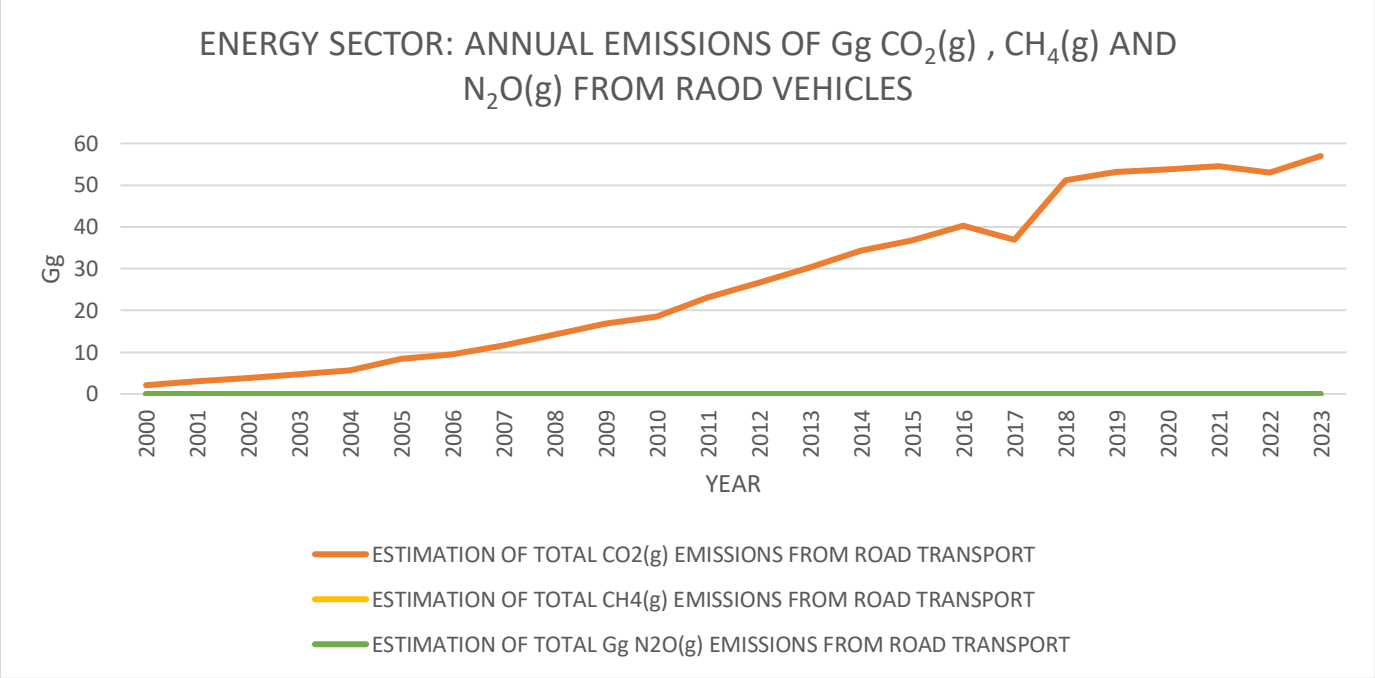


Figure 4: CO_2(g) is the primary emission contributor in the Road Vehicle sector, with annual increases correlating to rising vehicle numbers.

Figure 5: Energy Sector Emissions CO_2(g) Emissions: 2000 - 2023

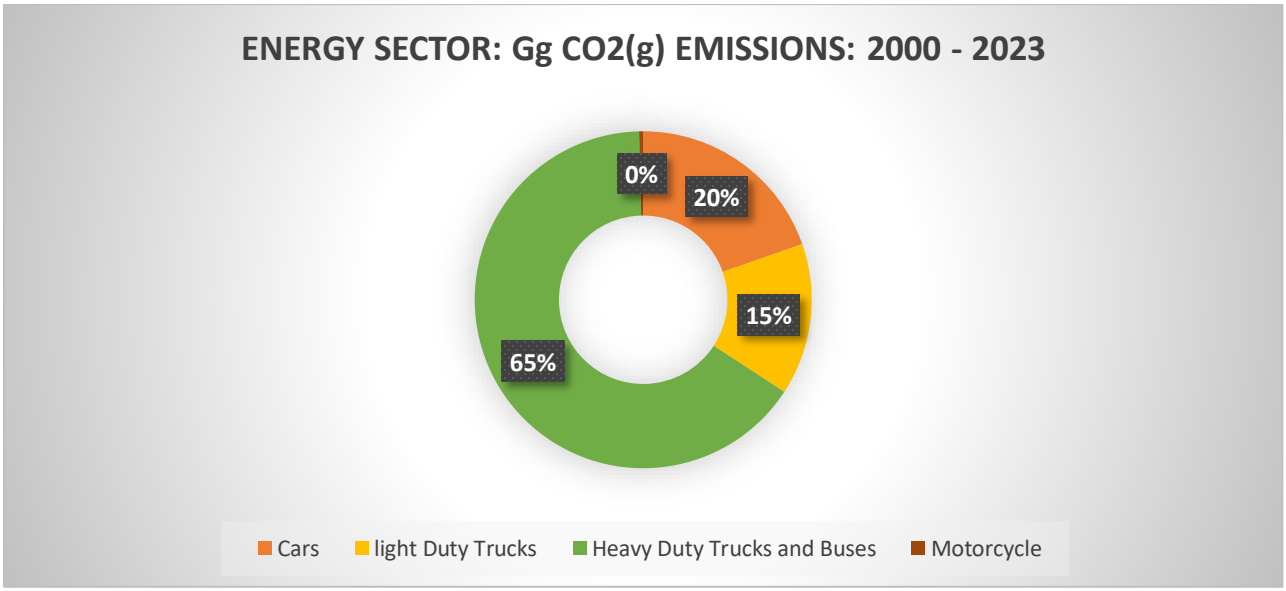


Figure 5 depicts that from 2000 to 2023, Heavy-Duty Trucks and Buses have been the primary contributors to carbon dioxide emissions from vehicle combustion, accounting for 65% of total emissions. Their larger engines and longer daily travel distances contribute significantly to this figure. Although cars are more numerous, they produce the second-highest emissions due to their prevalence on the roads, despite being smaller and typically covering shorter distances. Light-duty trucks follow cars in commonality and account for 15% of emissions; they are lighter than heavy-duty trucks but still travel shorter distances than buses. Motorcycles, being less common and lighter, show a negligible contribution to emissions, represented as 0% on the graph.

Overall sectoral Emissions produced from the Road Transport sector is increasing annually at a rate of 3.1431 Gg of CO_2 equivalent per year this can be evidently shown in Figure. Table 5 displays the total CO2 equivalent emissions from various road vehicles in Vanuatu.

Table 5.1: Energy Sector Road Transport Emissions Gg CO_2 equivalent: 2000 - 2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cars Emission Gg CO2 Equivalent	0.227202	0.38652	0.574931	0.756416	0.998856	1.346271	1.741586	2.1848	2.675913	3.214926	3.801838
light duty Trucks Emission Gg CO2 equivalent	0.522985	0.892561	1.248191	1.75723	2.308108	2.925694	3.591796	4.306414	5.069547	5.881196	6.74136
Heavy Duty Trucks Emission Gg CO2 equivalent	1.380754	1.994241	2.391781	3.005267	3.406079	5.48386	5.868948	7.371525	9.054864	10.91897	11.59911
Motorcycle Emission Gg CO2 equivalent	0.007067	0.014527	0.02238	0.028662	0.036907	0.044903	0.053516	0.062746	0.072592	0.083056	0.094137
Road Transport Total CO2 Equivalent	2.138009	3.28785	4.237283	5.547575	6.749951	9.80073	11.25585	13.92548	16.87292	20.09814	22.23644

Table 5.2: Energy Sector Road Transport Emissions Gg CO_2 equivalent: 2011 – 2020

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cars Emission Gg CO2 Equivalent	4.436649	5.11936	5.849971	6.628481	7.227688	7.942678	8.597962	9.45274	10.26041	10.76639
light duty Trucks Emission Gg CO2 equivalent	7.65004	8.607235	9.612946	10.66717	11.24693	12.02861	13.05018	14.0299	14.40994	14.51756
Heavy Duty Trucks Emission Gg CO2 equivalent	15.18945	17.59584	20.18299	22.9509	24.51882	27.03476	22.47961	35.64812	36.82438	36.80232
Motorcycle Emission Gg CO2 equivalent	0.105834	0.118149	0.13108	0.144628	0.151726	0.159049	0.166509	0.178287	0.186533	0.183641
Road Transport Total CO2 Equivalent	27.38198	31.44058	35.77698	40.39118	43.14516	47.1651	44.29426	59.30905	61.68126	62.26991

Table 5.3: Energy Sector Road Transport Emissions Gg CO_2 equivalent: 2021 – 2023

	2021	2022	2023
Cars Emission Gg CO2 Equivalent	11.32283	11.15946	12.3973
light duty Trucks Emission Gg CO2 equivalent	14.78237	14.263	14.88752
Heavy Duty Trucks Emission Gg CO2 equivalent	36.99377	35.78894	38.27568
Motorcycle Emission Gg CO2 equivalent	0.180918	0.174044	0.17951
Road Transport Total CO2 Equivalent	63.27989	61.38545	65.74001

(Note: The arrangement of tables has been separated for space considerations)

Figure 6: Energy Sector: Road Transport Emissions Gg CO_2 Equivalent: 2000 - 2023

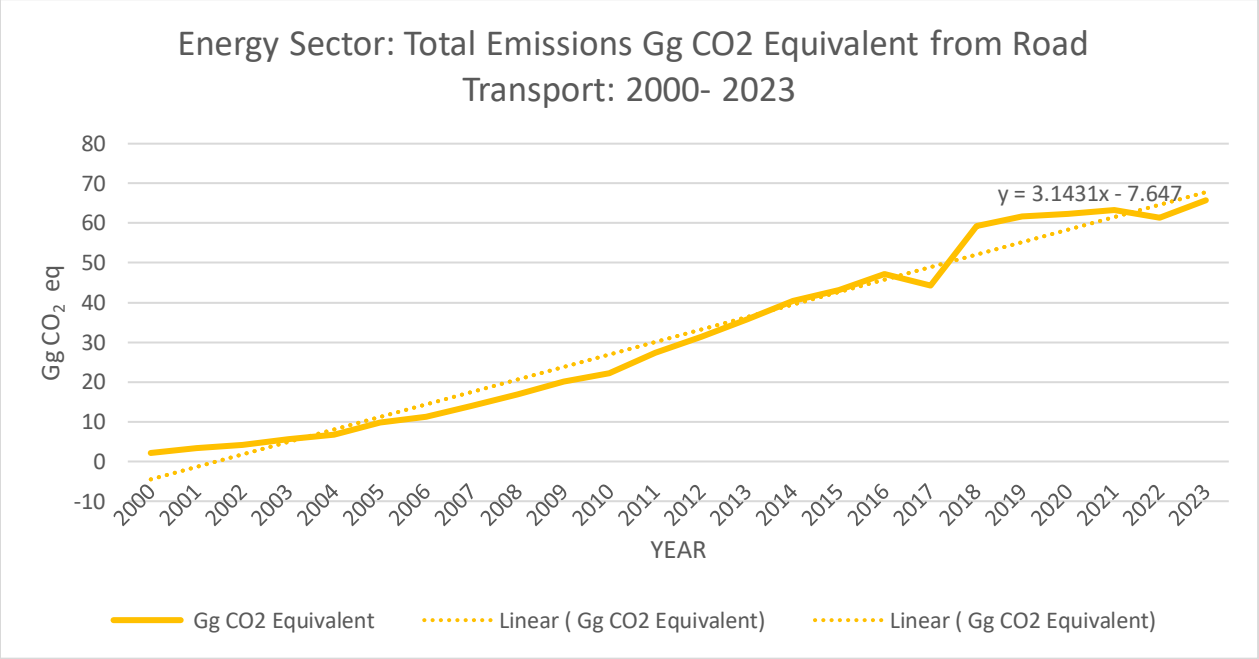


Figure 6 illustrates a yearly rise in CO2 equivalent emissions from the year 2000 to 2023, with an average increase of 3.1431 Gg of CO2 equivalent each year.