Greenhouse Gas (GHG) Emissions Baseline Report 2025

Establishing the Baseline for Decarbonizing Freight Transport along the Northern Corridor

December 2025

Northern Corridor Transit and Transport Coordination Authority

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Abbreviations and Acronyms

Acronym / Abbreviation	Full Term	Context / Description
AADT	Average Annual Daily Traffic	Average number of vehicles passing a point per day over a year
ADT	Average Daily Traffic	Average number of vehicles per day on a route
ASIF	Activity–Structure–Intensity–Fuel	Transport emissions decomposition framework
BAU	Business As Usual	Emissions projection without mitigation measures
BC	Black Carbon	Short-lived climate pollutant from diesel combustion
BMAU	Budget Monitoring and Accountability Unit	Uganda transport sector reference
CAGR	Compound Annual Growth Rate	Measure of annual growth over a period
CCAC	Climate and Clean Air Coalition	International partnership addressing air pollution and climate
CH_4	Methane	Greenhouse gas
CNG	Compressed Natural Gas	Alternative fuel option
CO_2	Carbon Dioxide	Primary greenhouse gas from fossil fuel combustion
CO_2e	Carbon Dioxide Equivalent	Standardized unit expressing total GHG impact
DRC	Democratic Republic of Congo	Northern Corridor Member State
EAC	East African Community	Regional regulatory reference
EEA	European Environment Agency	Emission factor source
EF	Emission Factor	Quantity of emissions per unit of activity
EMEP	European Monitoring and Evaluation Programme	Air pollutant inventory methodology
Euro I–VI	European Emission Standards	Vehicle emission regulatory standards

Acronym / Abbreviation	Full Term	Context / Description
EV	Electric Vehicle	Low-carbon transport technology
FE	Fuel Efficiency	Distance travelled per unit of fuel
GFEI	Global Fuel Economy Initiative	International fuel economy program
GHG	Greenhouse Gas	Gases that trap heat in the atmosphere
HCV	Heavy Commercial Vehicle	Trucks with ≥5 axles
HDV	Heavy Duty Vehicle	Emission regulation category
HFC	Hydrofluorocarbon	Industrial greenhouse gas
HGV	Heavy Goods Vehicle	Heavy freight vehicle classification
IPCC	Intergovernmental Panel on Climate Change	UN body providing climate science guidance
km	Kilometre	Unit of distance
kmpl or km/l	Kilometres per Litre	Measure of fuel efficiency/ Fuel efficiency unit (used interchangeably)
LDT	Light Duty Truck	Commercial trucks with two (2) axles
LF	Load Factor	Proportion of vehicle load capacity used
MC	Mobile Combustion	Emissions from vehicle fuel combustion
MCV	Medium Commercial Vehicle	Trucks with 3–4 axles
MGR	Meter Gauge Railway	Rail infrastructure
$MMtCO_2e$	Million Metric Tonnes of CO_2 Equivalent	Large-scale emissions reporting unit
$MtCO_2e$	Metric Tonnes of CO_2 Equivalent	Standard GHG emissions measurement unit
NASA	National Aeronautics and Space Administration	Climate science reference source
NCEM	Northern Corridor Emissions Model	GHG emissions estimation model used in the study
NCTTCA	Northern Corridor Transit and Transport Coordination Authority	Northern Corridor governing body
NDC	Nationally Determined Contribution	National climate commitments under UNFCCC
NF_3	Nitrogen Trifluoride	Industrial greenhouse gas
No_x	Nitrogen Oxides	Dominant transport air pollutant from combustion

Acronym / Abbreviation	Full Term	Context / Description
OSBP	One Stop Border Post	Integrated border processing facility
Paris Agreement	UNFCCC Paris Agreement	International climate agreement
PFC	Perfluorocarbon	Industrial greenhouse gas
PM	Particulate Matter	Air pollutant
PM10	Particulate Matter ≤10 microns	Fine inhalable air pollutant
QA/QC	Quality Assurance / Quality Control	Data validation framework
SF_6	Sulfur Hexafluoride	Industrial greenhouse gas
SGR	Standard Gauge Railway	Rail transport infrastructure
TEU	Twenty-Foot Equivalent Unit	Standard container measurement
TTW	Tank-to-Wheel	Vehicle operational emissions
UNCTAD	United Nations Conference on Trade and Development	UN trade and development body
UNEP	United Nations Environment Programme	UN environmental authority
UNFCCC	United Nations Framework Convention on Climate Change	International climate treaty
VKT	Vehicle Kilometres Travelled	Total distance travelled by vehicles
WB	World Bank	
WMO	World Meteorological Organization	Global climate monitoring body

Executive Summary

The Northern Corridor is a critical multimodal trade artery linking the Port of Mombasa to Burundi, the Democratic Republic of Congo (DRC), Kenya, Rwanda, South Sudan, and Uganda. In 2024, the corridor handled approximately 40.99 million metric tonnes (MT) of cargo, up from 24.88 million MT in 2014, representing an average annual growth rate of 5.1% over the past decade (NCTTCA, 2025). Road freight remains the dominant mode of transport, accounting for over 85% of total corridor cargo throughput, underscoring its central role in regional trade as well as its growing environmental footprint.

This 2024/2025 Greenhouse Gas (GHG) Emissions Baseline Survey was undertaken to quantify emissions from road freight transport along key Northern Corridor routes across the six Member States. Using the Northern Corridor Greenhouse Gas Emissions Estimation Model (NCEM), aligned with IPCC guidelines, the survey analyzed traffic and vehicle data from 29,172 average daily truck movements across 24 monitoring stations and a stratified sample of 5,334 trucks. Key findings include:

3.96

$MtCO_2e$/year

Emissions across six member States

Emissions

The baseline established total corridor annual road-freight emissions of approximately 3.96 million tonnes of CO_2 equivalent ($MtCO_2e$) and about 20,298 tonnes of air pollutants (NO_x, PM_{10}, and black carbon).

Kenya is the largest contributor, accounting for 2.59 $MtCO_2e$ (65%) of total corridor emissions, reflecting its role as the primary gateway through the Port of Mombasa and the concentration of long-haul freight activity. Uganda follows with 0.83 $MtCO_2e$ (21%), Rwanda with 0.34 $MtCO_2e$ (9%), South Sudan with 0.099 $MtCO_2e$ (3%), Burundi with 0.062 $MtCO_2e$ (2%), and surveyed routes in eastern DRC contributing approximately 0.04 $MtCO_2e$ (1%).

Pollutants

Total emissions of air pollutants from road freight transport along the Northern Corridor are estimated at approximately 20,298 tonnes/year. These emissions are overwhelmingly dominated by nitrogen oxides (NO_x), which account for ~94% of total pollutants, while particulate matter (PM_{10}) contributes ~5% and black carbon (BC) ~1%. Kenya contributes 15,271.5 tonnes/year (~75%), Uganda 3,682.2 tonnes/year (~18%), Rwanda 786.6 tonnes/year (~3.9%), South Sudan 426.2 tonnes/year (~2%), Burundi 211.7 tonnes/year (~1%), and the surveyed routes in eastern DRC 92 tonnes/year (~0.05).

20,298

Tonnes/year

Air pollutants across six member States

Traffic Dynamics

Traffic analysis shows that Kenya accounts for 53% of total corridor truck traffic (15,583 vehicles/day), followed by Uganda (26%) and Rwanda (13%). Across the corridor, Heavy Commercial Vehicles (HCVs, 5–6 axles) dominate freight movement, representing approximately 59–61% of all trucks, confirming the corridor's heavy reliance on long-haul diesel-powered vehicles. Notably, 45% of surveyed trucks were operating empty, indicating substantial inefficiencies in freight logistics and a significant opportunity for rapid emissions reductions through improved load matching and backhaul coordination.

Emissions Hotspots

The baseline identifies clear emissions hotspots, including Mombasa–Nairobi and Nairobi–Malaba in Kenya, Malaba/Busia–Kampala in Uganda, Kigali–Rusizi in Rwanda, Nimule–Juba in South Sudan, and Bunia–Kisangani in DRC. These routes combine high traffic volumes, long distances, and a predominance of heavy trucks, making them priority corridors for targeted mitigation interventions.

This baseline directly supports the implementation and monitoring of the Northern Corridor Green Freight Strategy 2030, which targets a 10% reduction in CO_2 intensity by 2030, a 12% reduction in key air pollutants (NO_x, PM_{10}, and black carbon), and net-zero emissions by 2050. It also strengthens compliance with Article 13 of the UNFCCC

Paris Agreement on transparency and provides a robust reference point for tracking progress against Member States' Nationally Determined Contributions (NDCs), including emissions reduction targets of 32% for Kenya, 38% for Rwanda, 29% for Uganda, 44% for South Sudan, and conditional or unconditional targets for Burundi and DRC.

To achieve these objectives, the report recommends a coordinated package of measures focused on eco-driving and operational efficiency, harmonization of vehicle emission and age standards, mandatory emissions testing, and improved fuel quality. Strategic investments in rail, inland waterways, and intermodal freight systems are identified as critical for enabling modal shift away from high-emission road freight. In the medium to long term, the accelerated deployment of low- and zero-emission technologies, particularly electric freight vehicles supported by charging infrastructure and fiscal incentives, will be essential. Continuous emissions monitoring through the Northern Corridor Emissions Tracker will ensure accountability, adaptive policy-making, and evidence-based investment decisions.

Overall, this 2024/2025 baseline provides the first comprehensive, corridor-wide, data-driven assessment of road freight emissions in East Africa. It establishes a critical foundation for balancing the Northern Corridor's continued trade growth with environmental sustainability, public health protection, and long-term climate resilience.

1 Introduction

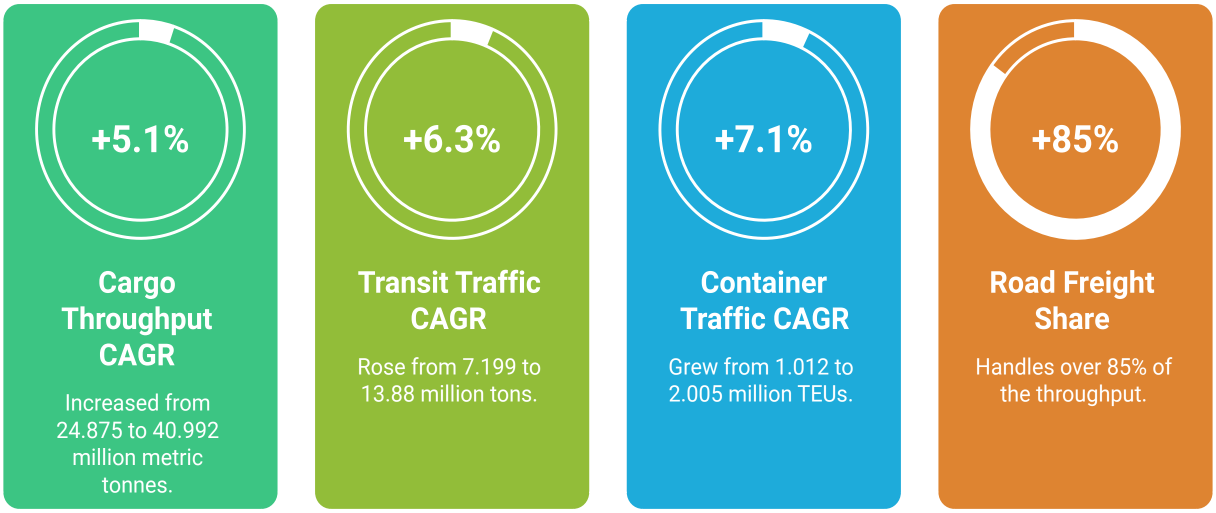
1.1 Background on the Northern Corridor

The Northern Corridor is a multimodal transport route connecting the Kenyan maritime Port of Mombasa to the hinterland countries of Burundi, the Democratic Republic of Congo (DRC), Rwanda, South Sudan, and Uganda. The corridor consists of the various surface modes of transport including road, rail, pipeline, and inland waterway transport. Its infrastructure includes the Port of Mombasa, inland ports, inland container depots, an extensive rail and road network, weighbridges, and border posts. Established under the Northern Corridor Transit Agreement in 1985 and revised in 2007 as the Northern Corridor Transit and Transport Agreement, the framework initially comprised 11 protocols. In 2020, a 12th protocol was added to address environmental sustainability, reflecting growing concerns over transport – related environmental impacts.

The Northern Corridor Transit and Transport Coordination Authority (NCTTCA), which oversees the implementation of the agreement, is tasked with facilitating trade and mobility, transforming the corridor into a development corridor through investment stimulation, and promoting strategies for economic and social advancement while prioritizing environmental sustainability.

The Port of Mombasa, the corridor's primary gateway, has seen significant trade growth over the past decade. Cargo throughput increased from 24.875 million metric tonnes in 2014 to 40.992 million metric tonnes in 2024, a compound annual growth rate (CAGR) of 5.1%. Transit traffic to neighboring countries rose from 7.199 million tons to 13.88 million tons over the same period (CAGR 6.3%), while container traffic grew from 1.012 million TEUs to 2.005 million TEUs, a CAGR of 7.1%. This escalation, with road freight handling over 85% of throughput, underscores the corridor's critical role and the associated environmental challenges.

Figure 1: Corridor Traffic Growth 2014 - 2024



To address its environmental mandate, the NCTTCA, in collaboration with the Climate and Clean Air Coalition (CCAC), United Nations Environment Programme (UNEP), and United Nations Conference on Trade and Development (UNCTAD), developed the Northern Corridor Green Freight Program (2017 – 2021). A review of this strategy identified gaps, including deficiencies in sustainable infrastructure, limited specialized expertise, and low public awareness. In response, an extraordinary Northern Corridor Executive Committee meeting in Nairobi in 2020 amended the agreement to incorporate mitigation measures for transport's environmental impacts and climate change effects on infrastructure. Building on this, the NCTTCA, with CCAC, UNEP, and Smart Freight Centre support, updated the program into the Northern Corridor Green Freight Strategy 2030.

The 2030 Strategy focuses on establishing baseline GHG emission levels from commercial trucks plying the Northern Corridor route against which the progress as it is being implemented will be tracked. The strategy set progress targets that were to be achieved by the year 2030. The specific targets set in the strategy were:

a) Improve the fuel efficiency of freight transport by 10% by 2030 compared to 2024 levels.
b) Reduce the CO_2 emissions intensity by 10% by 2030 compared to 2024 levels.
c) Reduce the particulate matter(PM). Black Carbon and oxides of Nitrogen(N0x) by 12% by 2030 compared to 2024.
d) Enhance climate Resilience of at least 2000km of roads.
e) Implement Eco – driving training for 1000 drivers.

While countries are mandated to report comprehensive national GHG inventories through their Nationally Determined Contributions (NDCs) as per UNFCCC Paris Agreement Article 13(7), the NCTTCA's effort enhances precision for the transport sector within these national frameworks. Article 13(7) requires parties to submit:

- *A national inventory of anthropogenic GHG emissions by sources and removals by sinks, using IPCC – accepted good practice methodologies;*
- *Information to track progress toward NDCs under Article 4 (UNFCCC).*

As a requirement of its Green Freight Strategy, NCTTCA conducted a GHG survey to establish the baseline emission levels for six member states of the Northern Corridor namely Burundi, DRC, Kenya, Rwanda, South Sudan, and Uganda in the year 2024/2025. The baseline survey was conducted in two phases with phase one covering Kenya, Rwanda and Uganda in the year 2024 and phase two covering the remaining three member states of Burundi, DRC and South Sudan in 2025. It is against the results obtained in the baseline surveys that progress of the set targets by NCTTCA Green Freight Strategy will be measured using an IPCC – derived measurement tool. This will complement national efforts under the Paris Agreement's Article 14 (paragraphs 2 and 3), which mandates a global stock take starting in 2023, recurring every five years, to guide NDC updates and enhance climate cooperation. Member states report bottom – up inventories via the **ASIF (Activity, Structure, Intensity, Fuel)** methodology, a framework for analyzing and disaggregating transport emissions by breaking them down into four components: **Activity** (the total amount of movement), **Structure** (the modal split between different transport types), **Intensity** (the energy consumed per unit of activity), and **Fuel** (the carbon intensity of the fuels used) (AfDB, 2009), meant to compare future emissions against baselines to evaluate NDC effectiveness through periodic surveys.

Currently, Northern Corridor member states estimate emissions using vehicle activity data and sector – specific emission factors (e.g., fuel consumption for transport), though reliance on assumptions limits precision. By directly measuring transport emissions along the corridor, the NCTTCA enhances data accuracy, supporting national reporting. The Northern Corridor road network spans about 12,712 km: 567 km (Burundi), 4,162 km (DRC), 1,328.6 km (Kenya), 1,039.4 km (Rwanda), 3,543 km (South Sudan), and 2,072 km (Uganda). Road conditions along the Northern Corridor route sections vary reflecting disparities in the quality of infrastructure which as a result affects emissions and fuel efficiency.

1.2 Introduction to Greenhouse Gases

Greenhouse gases (GHGs) are gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re – emit infrared radiation (UNFCCC 1992). They include carbon dioxide (CO_2), methane (CH_4), nitrous oxides, water vapor, and industrial fluorinated gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), Sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). The Naturally occurring GHGs, including CO_2, CH_4, N_2O, and water vapor, are essential components of Earth's atmosphere. In contrast, fluorinated gases are entirely human made, originating from industrial processes. Human activities such as industrialization, agriculture, and transportation increase the concentration of naturally occurring GHGs. Transport along the Northern Corridor plays a significant role due to its reliance on diesel – powered freight.

The greenhouse effect is a natural process where shortwave solar radiation passes through the atmosphere and warms Earth's surface. At night, the surface emits back longwave (infrared) radiation, which GHGs absorb, slowing its release into space. This process regulates atmospheric temperatures by reducing the rate of planetary cooling. However, elevated GHG concentrations from human activities intensify this effect, leading to global warming and exacerbating climate change (NASA, 2025).

Rising GHG levels from industrial growth, agricultural practices, and transportation have trapped additional heat, causing global temperatures to rise. This has led to adverse climate consequences, including erratic weather patterns, extreme droughts, floods, heatwaves, and ocean acidification. Recent climate events highlight this trend. In September 2023, Australia experienced severe heatwaves, while torrential rains flooded Libya. In October 2023, New York faced extreme flooding, and strong winds battered Europe. Asia recorded unprecedented heat in November 2023. In April 2024, the United States endured earthquakes, tornadoes, and storms exceeding 50 miles per hour. July 2024 became the warmest July on record (World Meteorological Organization, 2024).

Unmitigated global warming poses severe environmental and ecological threats, affecting human and animal life across member states. In response, the NCTTCA developed the Northern Corridor Green Freight Strategy 2030 to monitor GHG emissions from freight transport. This strategy sets out a roadmap to reduce anthropogenic emissions, supporting national climate goals and fostering a sustainable future for the region.

1.3 Objectives of the baseline survey

The 2024/2025 baseline survey aimed to establish a GHG emissions baseline for the road freight sector (commercial trucks) along the Northern Corridor in Burundi, DRC, Kenya, Rwanda, South Sudan and Uganda, providing corridor – specific data to support member states in tracking emission trends and evaluating the effectiveness of mitigation measures within their Nationally Determined Contributions (NDCs). While national governments are responsible for comprehensive NDC reporting under the UNFCCC Paris Agreement, the Northern Corridor Transit and Transport Coordination Authority (NCTTCA) contribute by focusing on emissions from this critical trade corridor.

This baseline, aligned with the Northern Corridor Green Freight Strategy 2030's long – term goal of achieving carbon neutrality by 2050, enables assessments of investment returns, future emissions projections, and the ongoing implementation of the Strategy's targets, including a 10% CO_2 intensity reduction by 2030.

Specifically, the survey sought to:

Tally by class all commercial trucks passing through designated stations along the Northern Corridor in Burundi, DRC, Kenya, Rwanda, South Sudan and Uganda, establishing a comprehensive traffic profile.

Collect vehicle activity data, including truck category, origin – destination, maximum loaded weight, actual weight, and fuel consumption for loaded and return trips, to characterize operational patterns.

Determine the average fuel required to transport one ton of cargo per kilometre across various Northern Corridor route sections in Burundi, DRC, Kenya, Rwanda, South Sudan and Uganda, quantifying transport efficiency.

Quantify and project GHG emissions from commercial trucks along the Northern Corridor in the member states, providing a foundation for regional emissions analysis and Strategy implementation tracking.

Identify potential strategies to reduce greenhouse gas (GHG) emissions and propose targeted climate change mitigation initiatives along the corridor, aligned with member states' sustainability goals and the overall objectives of the NCTTCA Green Freight Strategy

Develop a GHG data collection and reporting framework to enable regular monitoring of corridor emissions performance, assess the impact of mitigation initiatives over time, and track progress toward the Northern Corridor Green Freight Strategy 2030's goals.

1.4 Scope of the study

The Northern Corridor, as depicted in Figure 1, is a critical economic artery for East and Central Africa, facilitating trade through its multimodal transport network linking the Port of Mombasa in Kenya to Burundi, the Democratic Republic of Congo (DRC), Rwanda, South Sudan, and Uganda.

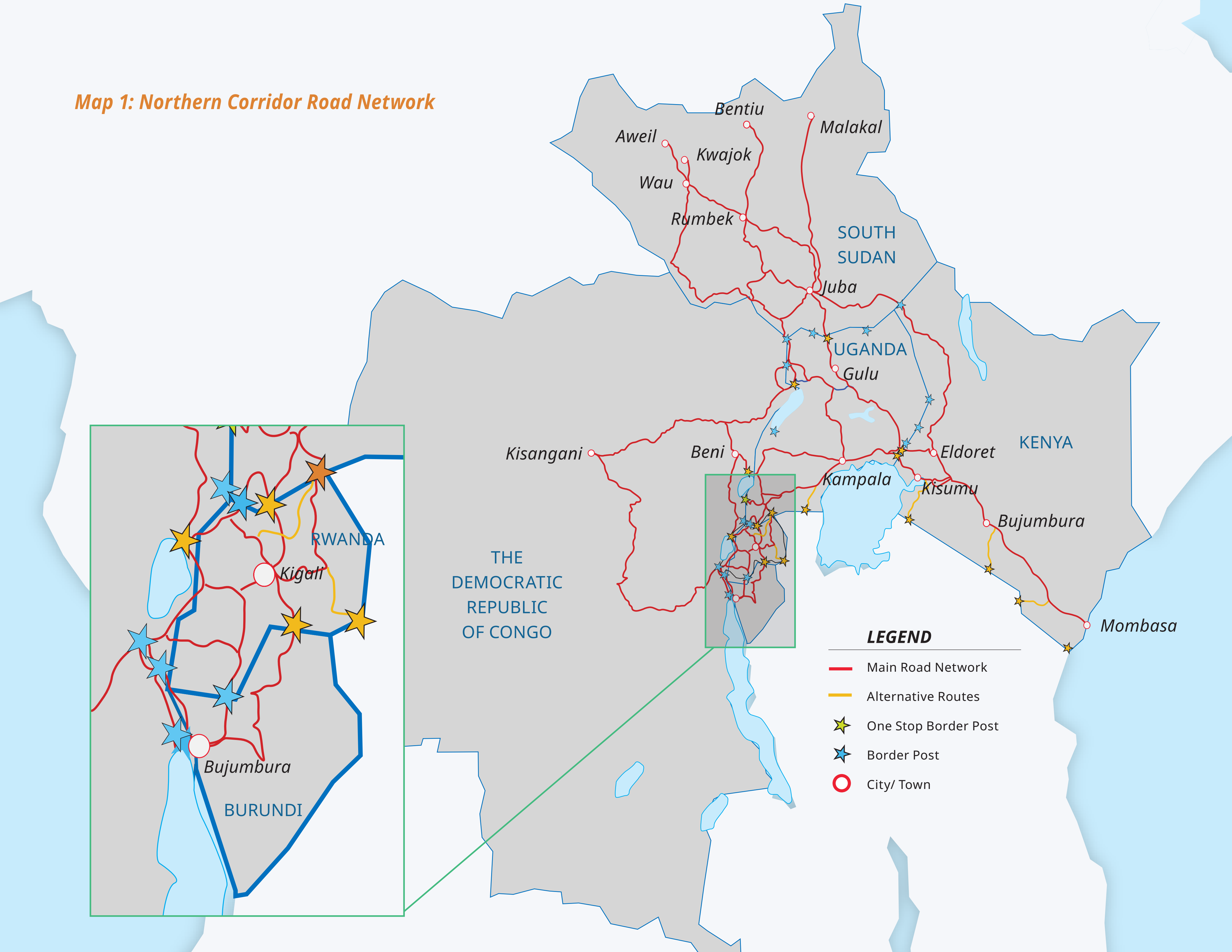
The road freight sector dominates cargo movement along the Corridor significantly contributing to greenhouse gas (GHG) emissions. This 2024/2025 baseline survey focused on quantifying GHG emissions from commercial trucks plying the Northern Corridor route sections in all member States, providing corridor – specific data to support national reporting under the UNFCCC Paris Agreement and Nationally Determined Contributions (NDCs). By establishing this baseline, the survey supports the Northern Corridor Green Freight Strategy 2030's implementation, enabling ongoing monitoring of emissions trends, mitigation effectiveness, and progress towards the Strategy's targets, including a 10% CO_2 intensity reduction by 2030 and carbon neutrality by 2050.

1.4.1 Greenhouse Gases Reported

The NCTTCA employed its GHG emissions estimation tool: the Northern Corridor GHG Emissions Model (NCEM) to quantify emissions from commercial trucks along the Northern Corridor. This 2024/2025 baseline survey focused on Carbon Dioxide (CO_2), Nitrous Oxides (NO_x), Particulate Matter (PM10), and Black Carbon (BC), reflecting the predominant emissions from diesel – powered freight vehicles. Total GHG emissions are reported in metric tonnes of CO_2 equivalent ($MtCO_2e$), providing a standardized measure of climate impact for monitoring progress toward the Strategy's targets.

While the Intergovernmental Panel on Climate Change (IPCC) recommends reporting a comprehensive range of GHGs for national inventories including CO_2, Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulfur Hexafluoride (SF_6), and Nitrogen Trifluoride (NF_3), the NCEM prioritizes CO_2, NO_x, PM10, and BC due to their dominant contribution to road freight emissions in the region and the availability of reliable, localized emission factors. Other GHGs, such as CH_4 and N_2O, are emitted in trace amounts from diesel combustion and lack sufficiently precise regional emission factors for quantification in this context. This targeted approach ensures accuracy and relevance for corridor – specific mitigation strategies, while also contributing, as a secondary benefit, to member states' broader national reporting efforts under the UNFCCC Paris Agreement and Nationally Determined Contributions (NDCs).

Map 1: Northern Corridor Road Network



1.4.2 GHG Emissions Vehicle Profiles

The 2024/2025 GHG baseline survey focused on the road freight sector along the Northern Corridor, targeting emissions from commercial trucks. It considered three key vehicle categories: Light – Duty Trucks (LDTs), Medium Commercial Vehicles (MCVs), and Heavy Commercial Vehicles (HCVs). These categories, defined by axle configuration, truck types, and load capacity, are critical to emissions profiles. Detailed traffic data and emissions quantification are presented in subsequent sections following the survey methodology.

1.4.3 Geographic Location

Given the extensive geographic coverage of the Northern Corridor across the six member states, the 2024/2025 GHG emissions baseline survey was implemented in two phases to ensure comprehensive data collection. The initial phase of the survey conducted in 2024 focused on quantifying emissions from the road freight sector (commercial trucks) in Kenya, Rwanda, and Uganda while the second phase conducted in 2025 was carried out in the member states of Burundi, DRC and South Sudan.

1.4.3.1 Burundi

In Burundi, the designated Northern Corridor routes are Akanyaru – Haut (through Kayanza – Bujumbura) to Gatumba, Gasenyi (through Kirundo – Ngozi) to Bujumbura, Ruhwa (through Rugombo – Nyamitanga) to Bujumbura, and Kanyaru – Bas (through Ngozi – Nyangungu) to Gitega to Kobero/Kabanga. For GHG emissions reporting, the route sections covered are Gitega – Bujumbura, Nemba - Ngozi – Kayanza – Bujumbura and Bujumbura – Gatumba (DRC border). The survey was carried out at Kabanga – Kobero OSBP for trucks plying Kobero into Burundi, and Bujumbura (city/port) for trucks plying between Bujumbura and Gatumba, as detailed in Table 1 below.

Table 1: GHG Survey Stations in Burundi

Survey Station	Routes Covered
Bujumbura	Traffic to/from Bujumbura to Gatumba (DRC Border) and Local Distribution
Kabanga – Kobero OSBP	Diverted traffic to/from Rwanda through Kabanga border, Kobero – Ngozi – Kayanza – Bujumbura

1.4.3.2 Democratic Republic of Congo (DRC)

In DRC, the survey was conducted at the borders of Bunagana, Kasindi/Mpondwe, and Mahagi/Goli, targeting traffic into and out of DRC, and onward links to Burundi, Kenya, Rwanda, Uganda, Tanzania and South Sudan. Kasindi is the busiest entry point into eastern DRC, characterized by heavy transshipment due to poor road conditions beyond the border and slow clearance processes. Bunagana serves as a border entry point into Eastern DRC to the South, while Mahagi border functions as a strategic feeder route into Eastern DRC to the North.

For GHG emissions reporting, the route sections covered are Mpondwe – Beni – Butembo, Bunagana – Rutshuru – Goma, and Goli – Bunia – Kisangani. The survey in all the three stations of DRC was carried out as detailed in Table 2 below:

Table 2: GHG Survey Stations in DRC

Survey Station	Routes Covered
Bunagana	Bunagana – Rutshuru – Goma
Mpondwe	Mpondwe – Beni – Butembo
Goli	Goli – Bunia – Kisangani

1.4.3.3 Kenya

In Kenya, the Northern Corridor trunk road originates from Mombasa running through Nairobi to Busia through Kisumu and to Malaba through Eldoret. Arterial routes radiate from the main route to Taita Taveta at Voi, to Namanga at Athi River, and to Isebania at Ahero. For Kenya, GHG reporting was done on three route sections of Mombasa – Nairobi, Nairobi – Malaba and Mau Summit – Busia with traffic data collected at five weighbridges; Mariakani, Athi River, Gilgil, Webuye, and Busia, as shown in the Table 3 below.

Table 3: GHG Survey Stations in Kenya

Survey Station	Routes Covered
Mariakani	Traffic to/from Mombasa
Athi River	Traffic to/from Namanga, Mombasa, Nairobi
Gilgil	Traffic to/from Nairobi and beyond
Webuye	Traffic to/from Malaba
Busia	Traffic to/from Busia

1.4.3.4 Rwanda

In Rwanda, the survey was conducted along the Gatuna – Kigali – Rubavu / Rusizi / Nemba / Akanyaru Haut routes at Gatuna, Cyanika, Rubavu, Shyorongi, Huye and Rusizi targeting traffic to and from Uganda, DRC and Burundi. Traffic from Tanzania was also captured on some routes.

The GHG reporting for Rwanda covered Gatuna – Kigali, Kigali – Rusizi, Cyanika – Rubavu and Musanze – Kigali route sections with data collected at the following stations below shown in Table 4:

Table 4: GHG Survey Stations in Rwanda

Survey Station	Routes Covered
Gatuna Border	Traffic to/from Uganda
Shyorongi	Internal traffic and cross – border flows
Rubavu	Cross – border traffic to and from Kigali, Uganda, and DRC
Cyanika	Cross – border traffic between Rwanda and Uganda, and local traffic
Rusizi	Cross – border traffic between Rwanda, Burundi and DRC, and local traffic
Huye	Cross – border traffic between Rwanda, Burundi and DRC, and local traffic

1.4.3.5 South Sudan

The survey in South Sudan was conducted at Nimule border and new bridge in Juba along the Nimule – Juba road. Nimule – Juba route serves as the main import route into South Sudan via the Northern corridor, linking the Nimule border to Juba via a 195 km stretch. Table 5 below summarizes the survey stations in South Sudan.

Table 5: GHG Survey Stations in South Sudan

Survey Station	Routes Covered
Nimule OSBP	Nimule (Uganda border) – Juba (195 km)
Juba New Bridge	Juba City & routes to North and West of Juba

1.4.3.6 Uganda

Uganda has the most extensive Northern Corridor routes from Malaba/Busia – Kampala – Katuna/Mirama Hills/Kyanika borders with Rwanda; to Bunagana/Mpondwe border with DRC; and Malaba – Tororo – Soroti – Gulu – Elegu border with South Sudan and to Goli/Paidha/ Vurra borders with DRC.

For GHG emissions reporting, the route sections covered are Malaba/Busia – Kampala, Kampala – Lukaya, Lukaya – Mbarara, Mbarara – Mpondwe, Mbarara – Katuna, Mbarara – Kyanika and Busia/Malaba – Elegu. The survey was carried out at Malaba, Mbale, Magamaga, Lukaya, Mbarara and Mpondwe as outlined in Table 6.

Table 6: GHG Survey Stations in Uganda

Survey Station	Routes Covered
Malaba	Cross – border trucks from Kenya to Uganda
Mbale	Cross – border trucks from Kenya to Uganda enroute to South Sudan and DRC through its northeast borders
Magamaga	Traffic excluding those destined to Tororo and those before Magamaga
Lukaya	Traffic through Kampala and other local Uganda routes
Mbarara	Traffic from Lukaya, local Uganda routes
Mpondwe Border	Cross – border trucks to and from Uganda to DRC

Photo: ©Artzzz | Dreamstime.com

2 Approaches and Methodology

2.1 Introduction

The methodology for this baseline survey was designed to provide a robust and data – driven assessment of greenhouse gas (GHG) emissions along the Northern Corridor. Anchored in a transport observatory framework, the study integrated primary data collection through real – time vehicle tallying, fuel consumption surveys and emission factor modeling with secondary data from relevant government agencies and industry reports. A combination of geospatial analysis, traffic volume monitoring, and stakeholder consultations ensured a comprehensive evaluation of emission patterns across different transport modes and corridor segments. This approach not only quantified emissions but also established benchmarks for future policy interventions aimed at decarbonizing freight and passenger transport within the corridor.

2.2 GHG Emission estimation approaches

To determine the GHG emission from the transport sector, the Energy (Input – based) Approach and the Activity (output – based) Approach can be adopted.

The Energy (Input – based) Approach

In calculating the GHG emission from the Energy (input – based) Approach, also known as the fuel consumption approach, it is necessary to determine the emission factors for the respective GHG gases. For example, the emission factor for CO_2 is estimated from the following equation:

$$\mathrm{EF} = \mathrm{CC} \times \delta \times \mathrm{X} \times \frac{\mathrm{KgCO_2}}{\mathrm{Litre\ of\ Fuel}}$$

Where:

CC = carbon content in fuel in mass percentage = 86 % = 0.86 for diesel

δ = fuel density = 0.820 [kg/l] for diesel

X = molecular weight relation for CO_2 = (12 μ + (2 × 16 μ))/12 μ = 44/12

Result for diesel fuel: 0.86 × 0.82 × (44/12) [kg/l] = 2.5857 [kg CO_2/liter of fuel].

For a vehicle whose fuel consumptions are known when empty and when fully loaded, the fuel consumption at a specified load factor can be calculated using the following formula:

$$\mathrm{FC_{LF}} = \mathrm{FC_{empty}} + (\mathrm{FC_{full}} - \mathrm{FC_{empty}}) \times \mathrm{LF}$$

Where:

$\mathrm{FC_{LF}}$ = Fuel consumption at the specified load factor (litres per KM)

$\mathrm{FC_{empty}}$ = Fuel consumption of empty vehicle

$\mathrm{FC_{full}}$ = Fuel consumption of fully loaded vehicle

LF = Specified load factor

The total Carbon dioxide emission is directly related to fuel consumption.

$$\mathrm{TE} = \mathrm{FC_{LF}} \times \mathrm{D} \times \mathrm{EF_{CO_2}}$$

Where :

TE = Total Carbon dioxide emission

$\mathrm{FC_{LF}}$ = Fuel consumption at specified load factor

D = Distance in Km

$\mathrm{EF_{CO_2}}$ = Emission factor for fuel (Kilograms of carbon dioxide per litre of fuel)

The Activity (output – based) Approach

In the absence of energy data, it is possible to make an estimate of the GHG emission footprint of a transport operation from the amount of work done and the energy consumed per unit of output which can be calculated from output of freight transportation generally measured in ton – kilometres divided by the energy consumed measured in liters.

Northern Corridor GHG Emission Estimation Model

The methodology for the 2024/2025 Baseline Survey of Greenhouse Gas Emissions along the Northern Corridor Routes was designed to deliver a robust, data–driven assessment of emissions from road freight transport, aligning with the Northern Corridor Green Freight Strategy 2030. The Northern Corridor GHG Emissions Estimation Model (NCEM) is used for the analysis of primary data from vehicle surveys with real–time traffic monitoring to quantify greenhouse gas (GHG) and pollutant emissions. This approach leverages a bottom–up methodology, emphasizing Vehicle Kilometres Travelled (VKT) and distance–based emission factors, ensuring precision for corridor–specific mitigation strategies targeting a 10% CO_2 intensity reduction by 2030 and net–zero emissions by 2050.

The NCEM adopts a *distance – based (output – based)* approach to estimate GHG and pollutant emissions, focusing on commercial trucks along the Northern Corridor. This method calculates emissions directly from the total distance travelled by each vehicle class, using emission factors expressed in grams per kilometre (g/km).

The key steps under NCEM include:

- Aggregating VKT per vehicle class and load status.
- Calculating weighted emission factors based on Euro standard shares.
- Applying g/km factors for pollutants and kg/L for CO_2.
- Summing across routes to derive totals

Vehicle Kilometres Travelled (VKT):

VKT is determined as the product of total daily traffic (trucks per day), route length (km), and 365 days per year, converted to million km/year.

Fuel Efficiency – This is the average amount of fuel used to transport a unit tonne – kilometre.

$$\mathrm{Fuel\ \ Efficiency} = \frac{\mathrm{Fuel\ \ Consumed}_{\mathrm{a,b}}}{\mathrm{Load} \times \mathrm{Distance}_{\mathrm{a,b}}}$$

Where:

a = fuel type

b = vehicle type (LDT, MCV, HCV)

Fuel Consumption:

Fuel consumption for loaded and empty trips is calculated separately using average fuel efficiency (km/L) for each vehicle class:

$$\mathrm{FC}_{\mathrm{a,b}} = \frac{\mathrm{VKT}_{\mathrm{a,b}}}{\mathrm{FE}_{\mathrm{ab}}} \qquad \textit{(Million L/Year)}$$

Where:

$\mathrm{VKT}_{\mathrm{a,b}}$ = VKT for loaded or empty trips.

$\mathrm{FE}_{\mathrm{ab}}$ = Fuel efficiency (km/L), sourced from survey

Loaded and empty VKT are apportioned based on the proportion of empty trucks.

Weighted Emission Factors for Pollutants:

The fleet composition is assessed by categorizing trucks according to Euro emission standards (Euro I to Euro VI). The share of trucks in each vehicle class (LDT/2 – Axle, MCV – 3/4 Axle, HCV – 5+/Axle) across these standards is determined from survey data.

Weighted average emission factors (g/km) for PM10, BC, and NO_x are calculated using the share of trucks and TTW emission factors *(TTW is the Tank – to – Wheel emissions: pollutants released directly by a vehicle as it operates)* for each Euro standard:

$$\mathrm{EF}_{\mathrm{weighted,\ \ pollutants,\ \ a,b}} = \sum_{\mathrm{Euro\ \ Std}} \left(\mathrm{EF}_{\mathrm{pollutant,\ \ Euro\ \ Std}} \times \mathrm{Share}_{\mathrm{Euro\ \ Std}}\right)$$

In estimating the considered GHG and pollutant emissions (CO_2, NOX, PM10, and BC) the following equations were used;

CO_2 Emissions:

Calculated using the total fuel consumption and a CO_2 emission factor of 2.5857 kg/L (adjusted for diesel):

$$\mathrm{E}_{\mathrm{CO_2}} = \sum_{\mathrm{a,b}} (\mathrm{FC}_{\mathrm{a,b}} \times \mathrm{EF}_{\mathrm{CO_2}} \times 1000) \qquad \textit{(Tonnes)}$$

Where:

$$\mathrm{FC}_{\mathrm{a,b}} = \frac{\mathrm{VKT}_{\mathrm{Loaded/Empty}}}{\mathrm{FE}_{\mathrm{a,b}}}$$

Where:

$\mathrm{E}_{\mathrm{CO_2}}$ = Total Carbon Dioxide (CO_2) emission of the corridor (tonnes)

$\mathrm{FC}_{\mathrm{a,b}}$ = Total fuel consumption of LDT/MCV/ HCV (Million litres/year)

$\mathrm{EF}_{\mathrm{CO_2}}$ = CO_2 emission factor for fuel (e.g. diesel) (kg/L)

$\mathrm{VKT}_{\mathrm{Loaded/Empty}}$ = Vehicle Kilometres Travelled (Km/year)

$\mathrm{FE}_{\mathrm{ab}}$ = Fuel Efficiency (kilometres per litre kmpl)

a = fuel type

b = vehicle type (LDT, MCV, HCV)

Pollutant Emissions (PM10, BC, NO_x):

$$\mathrm{E}_{\mathrm{pollutant}} = \mathrm{VKT}_{\mathrm{Loaded/Empty}} \times \mathrm{EF}_{\mathrm{Weighted\ \ pollutant\ \ Loaded/Empty}}$$

(Kg/Year)

Where:

$\mathrm{E}_{\mathrm{pollutant}}$ = Total emissions of the pollutant (PM10, BC, NO_x) measured in kilograms per year

$\mathrm{VKT}_{\mathrm{Loaded/Empty}}$ = Vehicle Kilometres Traveled (VKT) for a given category

$\mathrm{EF}_{\mathrm{Weighted\ \ pollutant\ \ Loaded/Empty}}$ = Weighted Emission Factor (EF) for a given pollutant, for loaded vehicle and Empty, measured in grams per kilometre (g/km).

Table 7: Northern Corridor GHG Emissions Quantification Template

Section Km											
	Total Daily Traffic	No of Trucks with Empty Load	Average Loading (Tons)	Average Fuel Efficiency (kmpl) - Loaded Truck	Average Fuel Efficiency (kmpl) - Empty Truck	Total Freight Movement (tonne- km)	Total Fuel Consumption (Diesel- Liters)	Total CO_2 Emissions (Tonnes)	Total PM10 Emissions (Kg)	Total BC Emissions (Kg)	Total NOx Emissions (Kg)
LDT											
MCV - 3Axle											
MCV-4 Axle											
HCV- 5 & 6 Axle											
HCV- 7 & 8 Axle											
HCV- >8 Axle											
Total											

2.4 Data Collection and Sampling Methods

2.4.1 Sampling methods and sample size

Data collection for the GHG emission calculations followed an activity – based approach, comprising two complementary activities:

i). **Trucks Tallying Module:** A full tally of all heavy commercial trucks (≥3.5 tons) passing through each survey station was conducted to determine total traffic volume. This count, which covered both inbound and outbound movements, was categorized by vehicle class. Tallying was performed over a 24 – hour day/night shift, aligned with the operational hours of the border posts.

ii). **Trucks Activity Module:** To gather operational data, a stratified random sampling method was employed. The truck population was first stratified into categories based on axle configuration and type (e.g., LDT/2 – Axle, MCV – 3 Axle), as these characteristics directly influence load capacity and fuel consumption. This approach ensured a representative sample across all vehicle classes. Enumerators then interviewed drivers from these stratified groups to collect data on trip specifics, including origin – destination, maximum and actual load, and fuel consumed.

The total number of trucks sampled through this methodology across the Northern Corridor Member States is summarized in Table 8 below.

Table 8: Total Sampled Trucks per Category and Country

Vehicle Class	Burundi	DRC	Kenya	Rwanda	South Sudan	Uganda	Total
HCV – >8Axle	0	40	4	22	30	7	**103**
HCV – 5&6Axle	315	220	1,426	292	200	867	**3,320**
HCV – 7&8Axle	22	70	23	21	60	24	**220**
LDT/2 – Axle	320	90	181	60	80	151	**882**
MCV – 3Axle	234	110	64	40	100	29	**577**
MCV – 4Axle	33	80	25	14	70	10	**232**
Total	**924**	**610**	**1,723**	**449**	**540**	**1,088**	**5,334**

2.4.2 Data Collection Tools and Instruments

The GHG emission data collection from freight transport in Burundi, DRC, Kenya, Rwanda, South Sudan and Uganda was done using structured questionnaires on a mobile data collection tool (KoBo toolbox). This mobile – based tool was selected for its ability to enhance data accuracy and efficiency. Key advantages included:

- **Real – time Validation:** Built – in data validation checks minimized enumeration errors during collection.
- **Elimination of Transcription:** Digital capture removed the need for manual data entry from paper forms, speeding up analysis and reducing errors.

Both the truck tallying and vehicle activity surveys were conducted using this platform. The corresponding questionnaires are provided in Appendix 1.

The collected data was processed using the Northern Corridor GHG emission estimation tool. This tool employs an activity – based methodology, aligned with the Intergovernmental Panel on Climate Change (IPCC) accounting guidelines to calculate emissions.

2.5 Quality Assurance and Quality Control for Data Collection

A rigorous quality assurance process was implemented to ensure the reliability of the emissions data. The NCTTCA's estimation tool was used to quantify emissions, with a focus on key pollutants from diesel – powered freight: Carbon Dioxide (CO_2), Nitrous Oxides (NO_x), Particulate Matter (PM10), and Black Carbon (BC). Total greenhouse gas emissions are reported in metric tonnes of CO_2 equivalent ($MtCO_2e$).

This focused scope, while narrower than the full range of gases recommended by the IPCC, is strategically aligned with regional priorities and data constraints. It prioritizes the most significant emissions from the road freight sector. Other gases, such as Methane (CH_4) and Nitrous Oxide (N_2O), are emitted only in trace amounts from diesel combustion.

The quality control procedure involved:

1. **Data Cleaning:** The dataset was scrubbed for outliers, such as implausible extremes in fuel efficiency, as well as renaming misspelt locations.
2. **Model Application:** Analysis was conducted using the Revised Northern Corridor Emissions Model (NCEM).
3. **Data Cross – Checking:** Key variables, including Vehicle Kilometres Travelled (VKT), fuel consumption, and Euro standard distributions, were cross – referenced with transport observatory data to ensure consistency with established baselines, such as the 2018 survey results.

2.6 Data Capture and Calculation Methodology

The GHG emission calculations were carried out based on the Northern Corridor model and are in line with the IPCC guidelines. Based on the model, data required for GHG emission calculations, and its nomenclature is summarized in the Table 9 below.

Table 9: List of data required for GHG emission model

Data monitored for GHG emissions model	Nomenclature	Source
Vehicle categorization according to axle	LDT – 2 axles MCV – 3 & 4 axles HGV – 5,6,7,8,9 &10 axles	The vehicles are classified as per the East African Community Vehicle Load Control Act, 2016 and data from the Northern Corridor Transport Observatory
Average annual daily traffic (number of vehicles by category (Light, Medium, and Heavy commercial vehicles))	AADTLDT/MCV/HGV	Survey Data
Length of corridor sections (km)	Length of the corridor	Northern Corridor Transport Observatory
Average weight of trucks by vehicle category (tonnes)	Average weight of LDT/MCV/HGV	Survey Data

Data monitored for GHG emissions model	Nomenclature	Source
Fuel efficiency data of trucks by vehicle category (km/litre)	FELDT/MCV/HGV	Survey Data
GHGs (CO_2) emission factor of fuel used in trucks ($MtCO_2$/TJ)	CO_2 emission factor of the fuel	IPCC guidelines for National Greenhouse Gas Inventories, Volume 2 – Energy, Chapter 3 Mobile Combustion (Page 3.16)
Pollutants (NO_x, PM, BC) emission factor of fuel used in trucks (g/kg of fuel)	Pollutants (NO_x, PM, BC) emission factor	EMEP EEA Air Pollutant Emission Inventory Guidebook, 2016, Part B Sectoral guidance chapters, Chapter 1 Energy

2.7 Data Analysis

The activity – based estimation of greenhouse gas (GHG) emissions along the Northern Corridor was conducted using a structured methodology that integrated real – time data collection, stratified random sampling, and statistical data analysis. The analysis focused on quantifying emissions from road freight transport by evaluating truck movements, fuel consumption, and freight volumes. The approach adhered to internationally recognized GHG accounting standards, ensuring accuracy, transparency, and applicability to regional transport policies.

To ensure the integrity and reliability of the collected data, a Quality Assurance and Quality Control (QA/QC) framework was implemented. This involved cross – checking data for inconsistencies, transcription errors, and completeness. The data validation process included consistency checks between survey data and transport observatory data. The dataset was also assessed for outliers, such as extreme fuel consumption values, and necessary corrections were made before analysis.

Once cleaned, the data was subjected to statistical analysis to determine the distribution of vehicle types, average loading, fuel efficiency trends, and emission profiles across different corridor sections.

The NCEM was used to compute emissions based on the bottom – up approach. This model calculates emissions using three key variables:

- **Vehicle Kilometres Traveled (VKT) –** Measured from traffic counts and truck surveys.
- **Freight Volume (ton – km) –** Derived from truck weights and distances traveled.
- **Fuel Efficiency (km/l) –** Categorized by truck type and load status (loaded vs. empty).

Emission factors were sourced from internationally recognized datasets such as the ***IPCC GHG Inventory Guidelines*** and the ***EMEP EEA Air Pollutant Emission Inventory Guidebook***.

3 Findings

3.1 Introduction

The freight transport sector along the Northern Corridor is pivotal for economic integration and trade facilitation across East Africa. However, it is a significant source of greenhouse gas (GHG) and pollutant emissions, contributing to regional environmental challenges. This chapter presents the findings on GHG and pollutant emissions from road freight transport in Burundi, DRC, Kenya, Rwanda, South Sudan, and Uganda,

The findings section outlines traffic distribution, fuel efficiency, emissions by vehicle category, and environmental impacts while identifying potential mitigation strategies. The findings will form the baseline for GHG estimation along the Northern Corridor using the Northern Corridor Greenhouse Gas Emissions Estimation Model (NCEM).

3.2 Summary Findings

The 2024/2025 baseline survey estimates that road-freight transport along the key Northern Corridor routes generates approximately 3.96 million tonnes of CO_2 equivalent ($MtCO_2e$) per year. Kenya is the largest contributor, accounting for about 2.59 $MtCO_2e$ (65%) of total emissions. Uganda contributes an estimated 0.83 $MtCO_2e$ (21%), followed by Rwanda with 0.34 $MtCO_2e$ (9%), South Sudan with 0.099 $MtCO_2e$ (3%), Burundi with 0.062 $MtCO_2e$ (2%), and the surveyed routes in eastern DRC with approximately 0.04 $MtCO_2e$ (1%).

In addition to greenhouse gases, total emissions of air pollutants are estimated at approximately 20,298 tonnes per year. These emissions are dominated by nitrogen oxides (NO_x), which account for more than 94%, while PM_{10} contributes about 5% and black carbon approximately 1%.

The total average daily traffic (ADT) for road freight transport along surveyed sections of the Northern Corridor across six countries is 29,172 vehicles. Kenya dominates with 15,583 vehicles/day (53% of total), followed by Uganda with 7,443 vehicles/day (26%), Rwanda with 3,764 vehicles/day (13%), Burundi with 924 vehicles/day (3%), South Sudan with 888 vehicles/day (3%), and DRC with 570 vehicles/day (2%). Kenya's leading position is driven by its role as the primary gateway to East Africa through the Port of Mombasa. Heavy Commercial Vehicles (HCV – 5&6 Axle) are the backbone of regional freight, representing 59% of total traffic across all countries, underscoring the corridor's focus on long – haul heavy goods movement.

Fuel consumption varied when loaded and empty based on vehicle classes, where some classes gain efficiency when empty while others lose it, indicating operational inconsistencies linked to terrain, vehicle condition, and load management. While fuel consumption improves when trucks run empty for some vehicle classes, this efficiency is achieved while performing no freight – moving work. This provides an opportunity for emissions reduction through improved logistics and cargo optimization to reduce empty runs.

In Burundi, Gitega – Gatumba and Nemba-Bujumbura route (estimated 20% of total traffic) generated 0.062387 $MtCO_2e$ and 211.68 tonnes/year of pollutants with NOx accounting for 94%. The freight activity recorded an average daily traffic of 924 trucks, dominated by LDT/2 – Axle (35%), MCV – 3 Axle (25%) and HCV – 5 & 6 Axle (34%) vehicle classes. For vehicle categories, containerized and tipper trucks accounted for 60% of traffic. The freight logistics fleet has a median age of 6 years.

	Burundi	DRC	Kenya	Rwanda	South Sudan	Uganda
CO_2 Emissions 3.96 $MMtCO_2e$	**0.062** $MMtCO_2e$ (**2%**)	**0.04** $MMtCO_2e$ (**1%**)	**2.59** $MMtCO_2e$ (**65%**)	**0.34** $MMtCO_2e$ (**9%**)	**0.099** $MMtCO_2e$ (**3%**)	**0.83** $MMtCO_2e$ (**21%**)
Air Pollutants NO_x is >94% (Total: 20,298 tonnes/year)	**211.7** tonnes/year	**92** tonnes/year	**15,271.5** tonnes/year	**786.6** tonnes/year	**426.2** tonnes/year	**3,682.2** tonnes/year
Traffic Volume 29,172 Vehicles/day	**924** vehicles/day (**3%**)	**570** vehicles/day (**2%**)	**15,583** vehicles/day (**53%**)	**3,764** vehicles/day (**13%**)	**888** vehicles/day (**3%**)	**7,443** vehicles/day (**26%**)
Key Emission Routes	Gitega–Gatumba (**66%**); Nemba–Bujumbura (**34%**)	Bunia–Kisangani (**39%**); Goli–Bunia (**27%**)	Mombasa–Nairobi (**61%**) and Nairobi–Malaba (**36%**)	Kigali–Rusizi (**84%**)	Nimule–Juba (Only reported route)	Malaba/Busia–Kampala (**42%**); Busia/Malaba–Elegu (**31%**)
Heavy Commercial Vehicles HCV–5&6 Axle (~59%); LDT/2-Axle 29% of total traffic	Mixed (LDT **35%**, MCV **25%**, HCV **34%**)	HCV dominant (**~73%**)	HCV–5&6 Axle **65%** of truck traffic	Light-Duty Trucks (LDT/2-Axle) **47%**; HCV–5&6 Axle **23%** of truck traffic	HCV–5&6 Axle **73%** of truck traffic	HCV–5&6 Axle **64%** of truck traffic
Emission Reduction Targets	**20%** (conditional) by 2030	**19%** (conditional) by 2030	**32%** reduction by 2030	**38%** reduction by 2030	**44%** reduction by 2030	**29%** reduction by 2030

DRC total GHG emissions along the Northern Corridor routes was 0.0369 $MtCO_2e$ with Bunia – Kisangani, Goli – Bunia and Kasindi – Beni accounting for most of the emissions at 39%, 27% and 16%, respectively. The high percentage emission along the Bunia – Kisangani route section is due to its long stretch. The average daily traffic registered in DRC was 570. HCV – 5&6 Axle trucks were the majority (39%), followed by smaller LDT and MCV categories.

Kenya total GHG emissions was 2.59 $MtCO_2e$ with the highest contribution from the routes sections of Mombasa – Nairobi (1.58 $MtCO_2e$) and Nairobi – Malaba (0.93 $MtCO_2e$). The total pollutants recorded were the highest load at 15,271.5 tonnes/year with the highest percentage being NOx at 94%. Kenya recorded the highest average daily traffic along the corridor at 15,583 (53% of all corridor traffic), driven by its gateway role through the Port of Mombasa. The road freight sector is dominated by HCV – 5&6 Axle (65%) vehicle classes, with smaller LDTs supporting local distribution.

Rwanda total GHG emissions reached was 0.34 $MtCO_2e$ with the Kigali – Rusizi route section as the highest contributor at 84%, while pollutant emissions reached 786.6 tonnes/year. The average daily traffic was 3,764 with LDT/2 – Axle vehicle class dominating at 47% reflecting its strong reliance on smaller vehicles for domestic distribution and mountainous terrain. Rwanda's EV freight programme, stricter fuel – quality standards, fleet renewal, improved cross – border logistics and public – transport focus supports its 38% GHG reduction target by 2030 (Rwanda NDC).

The total emission in South Sudan along the Nimule – Juba route sections reached 0.098951 $MtCO_2e$, with pollutants amounting to 426 tonnes/year, 94% of which is NOx. The average daily traffic was 888 trucks, dominated by HCV – 5&6 Axle (73%). Containerized and tankers were the main truck categories at 37% and 21%, respectively. South Sudan is characterized by an ageing fleet (median 16 years) and poor road conditions contributing to low fuel efficiency. South Sudan's NDC targets a 44% reduction in transport emissions by 2030 through low – carbon technologies and restrictions on inefficient vehicle import.

Uganda recorded 0.83 $MtCO_2e$ in total emissions. The two route sections – Malaba/Busia – Kampala and Busia/Malaba – Elegu together accounted for 73% of the total emissions Uganda is the second – highest freight mover in the region with average daily traffic of 7443 trucks, dominated by HCV – 5 & 6 Axle at 64% of total traffic. Containerized and box body trucks account for most freight movements reflecting Uganda's central role in regional trade flows. Uganda's NDC targets a 29% transport – sector reduction by 2030 via railway rehabilitation, 20% fuel – economy improvement under GFEI, and gradual alternative – fuel adoption.

Across the region, approximately 55% of sampled trucks were loaded, implying that 45% of all vehicle – kilometres are run empty, a major driver of unnecessary fuel consumption and emissions. Fuel efficiency improves when heavy and medium trucks run empty, confirming that poor backhaul coordination and load matching are low – hanging fruit for rapid emissions reductions. Pollutant emissions volume follow the same geographic pattern as CO_2 emissions, with NOx constituting over 94% of total pollutants in every country.

While Kenya, Rwanda and Uganda drive the bulk of Northern Corridor freight volume and emissions, smaller contributors such as Burundi, DRC, and South Sudan exhibit distinct vehicle – mix and operational challenges. Regional cooperation on logistics platforms to reduce empty running, harmonized vehicle – age and fuel – quality standards, accelerated railway revival, and targeted electrification of high – traffic corridors offer the highest – impact pathways to align road freight with the countries' collective NDC commitments and long – term decarbonization of East African trade.

3.3 Average Daily Traffic

The total average daily traffic for road freight transport across the surveyed route sections in the six Northern Corridor countries is 29,172 vehicles. The distribution of vehicle classes is detailed in the Table 10 below:

Table 10: Average Daily Traffic per Class

Vehicle Class	Burundi	DRC	Kenya	Rwanda	South Sudan	Uganda	Total	% Class
LDT/2 – Axle	320	107	4,206	1,775	107	1,953	**8,468**	**29%**
MCV – 3Axle	234	29	1,065	914	81	401	**2,724**	**9%**
MCV – 4Axle	33	18	131	84	15	189	**470**	**2%**
HCV – 5&6Axle	315	380	10,110	850	647	4,775	**17,077**	**59%**
HCV – 7&8Axle	22	36	58	133	36	121	**406**	**1%**
HCV – >8Axle	0	0	13	8	2	4	**27**	**0.09%**
Total	**924**	**570**	**15,583**	**3,764**	**888**	**7,443**	**29,172**	**100%**

Kenya recorded the highest traffic volume accounting for 53% of the total daily traffic, Uganda 26%, Rwanda 13%, Burundi 3%, South Sudan 3%, and DRC 2%. Kenya's dominance can be attributed to its strategic position as the primary gateway to East Africa through the Port of Mombasa.

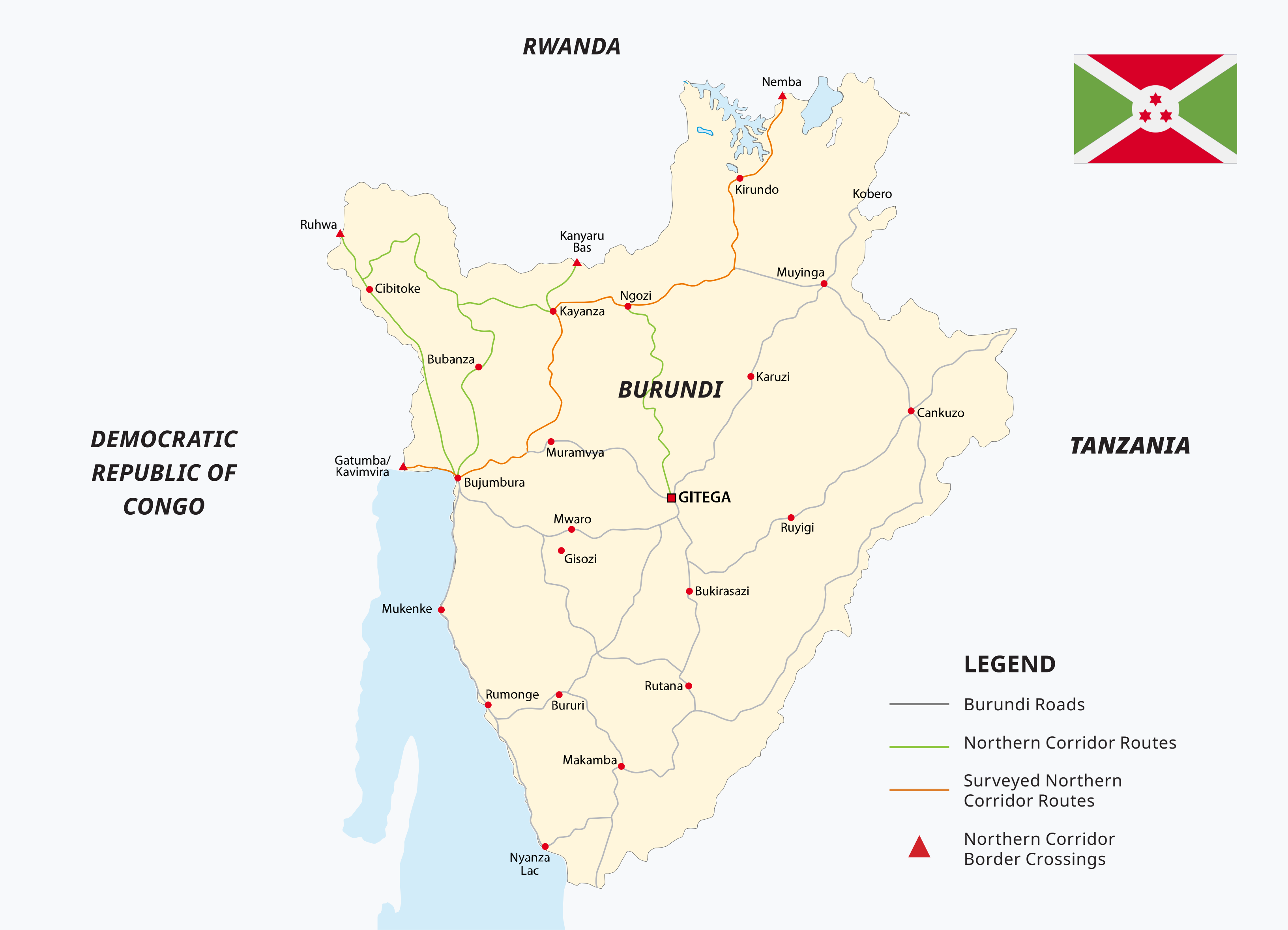
Overall, for the member States of Burundi, DRC, Kenya, South Sudan and Uganda, Heavy Commercial Vehicles (HCV – 5&6 Axle) dominated regional freight transport followed by Light – Duty Trucks (LDT/2 – Axle) and Medium – Commercial Vehicles (MCV – 3 Axle). In Rwanda, LDT/2 – Axle was the leading truck category followed by MCV – 3 Axle, and HCV 5&6 Axle categories respectively. LDTs are vital for last – mile delivery and local distribution.

3.4 Percentage of Loaded Trucks

The survey across the six Northern Corridor Member States shows that out of 5,334 sampled trucks, approximately 55% for each country were loaded. This high number of empty trips (45%) leads to increased fuel consumption and increased emissions.

3.5 Median age for trucks per class per country

Fleet age has significant implications for greenhouse gas emissions, fuel efficiency, and road safety. Older truck fleets tend to be less efficient and more emission intensive. The median age of sampled trucks varies notably across the region, ranging from relatively young fleets in Burundi and Rwanda at six (6) years, and Uganda at seven (7) years, to older fleets in Kenya at nine (9) years and the Democratic Republic of the Congo at 11 years, with South Sudan recording the oldest fleet at 16 years. While this suggests that newer trucks are being used for major freight routes in some Member States, the overall regional fleet remains outdated, contributing to higher emissions.



3.6 Burundi

3.6.1 Average Daily Traffic in Burundi

In Burundi, the road sub-sector is the dominant mode of transport, accounting for approximately 90 percent of passenger and freight movements (World Bank, 2022). Within the context of the Northern Corridor, Burundi's routes primarily serve traffic connecting to and from Rwanda and the Democratic Republic of Congo (DRC).

During the survey period, the Burundi – Rwanda border, which is the main entry point for Northern Corridor traffic into Burundi, was closed. As a result, Northern Corridor traffic normally transiting through Rwanda was diverted via the Rusumo border between Rwanda and Tanzania, and subsequently entered Burundi through the Kobero/Kabanga border with Tanzania.

Traffic surveys conducted at Kobero indicated that approximately 20 percent of the observed truck traffic consisted of diverted Northern Corridor flows originally destined to transit through Rwanda. For the purpose of estimating emissions along Northern Corridor routes in Burundi, this diversion was explicitly accounted for in the traffic allocation. Accordingly, 20 percent of the estimated Northern Corridor traffic was applied to the Nemba – Ngozi – Bujumbura route section, while the remaining 80 percent was allocated to the Gitega – Bujumbura route section as summarized in Table 11. Traffic along the Bujumbura–Gatumba section was surveyed separately.

Table 11: Average Daily Traffic per Class in Burundi

Vehicle Class	Nemba-Bujumbura	Gitega-Gatumba	Total
LDT/2 – Axle	64	256	**320**
MCV – 3 Axle	47	187	**234**
MCV – 4 Axle	7	26	**33**
HCV – 5&6 Axle	63	252	**315**
HCV – 7&8 Axle	4	18	**22**
HCV – >8 Axle	0	0	**0**
Total	**185**	**739**	**924**

3.6.2 Traffic Distribution per Category

The analysis of truck traffic in Burundi by vehicle type revealed containerized trucks, tippers and box body trucks dominated the freight transport, collectively accounting for about 81% of the freight movement. Table 12 presents the distribution of different vehicle types along the corridor:

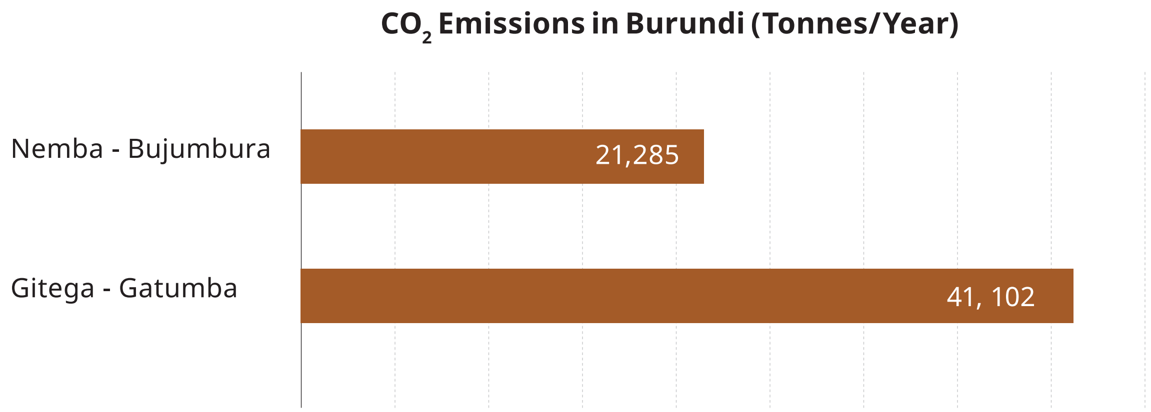
Table 12: Traffic Distribution per Category in Burundi

Vehicle Type	Percentage
Box body truck	21%
Containerized truck	33%
Other	5%
Skeleton truck	5%
Tanker Truck	8%
Tipper	27%

3.6.3 CO_2 Emissions per Road Section

The estimated GHG emissions for Burundi was 0.062387 $MtCO_2e$ along the Gitega–Gatumba (112km) and Nemba-Bujumbura route (232 km). Within the same route, the Gitega–Gatumba section of the Northern Corridor, covering 112 km, contributes 0.0411019 $MtCO_2e$ of emissions, with the Nemba - Bujumbura route, estimated at 20% of the total traffic recorded in Burundi recording an estimated 0.021285 $MtCO_2e$ as illustrated in Figure 2.

Figure 2: CO_2 Emissions per the Road Section in Burundi



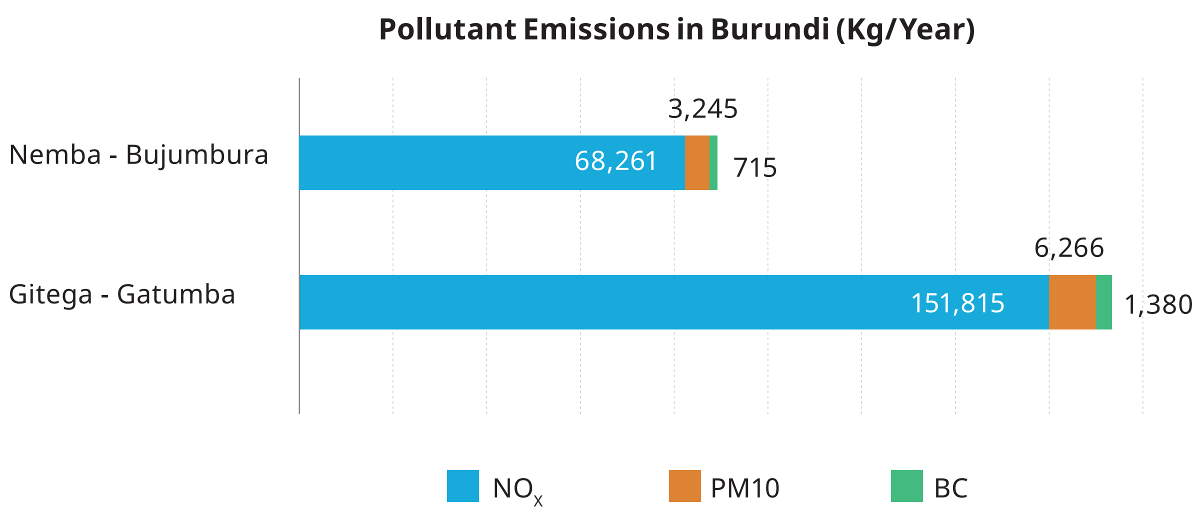
Burundi identifies freight transport as a significant source of greenhouse gas emissions within its energy sector. Under its Nationally Determined Contribution (NDC), the country commits to an unconditional emissions reduction of 3% by 2025 and a conditional reduction of 20% by 2030, subject to international support. These targets are measured against a business-as-usual (BAU) projection of 3.02 $MtCO_2e$ in 2030. Within this projection, emissions from the energy sector are expected to reach 1.65 $MtCO_2e$, while the Forestry and Other Land Use sector is projected to provide a carbon sink of 2.09 $MtCO_2e$ (Burundi NDC, 2025).

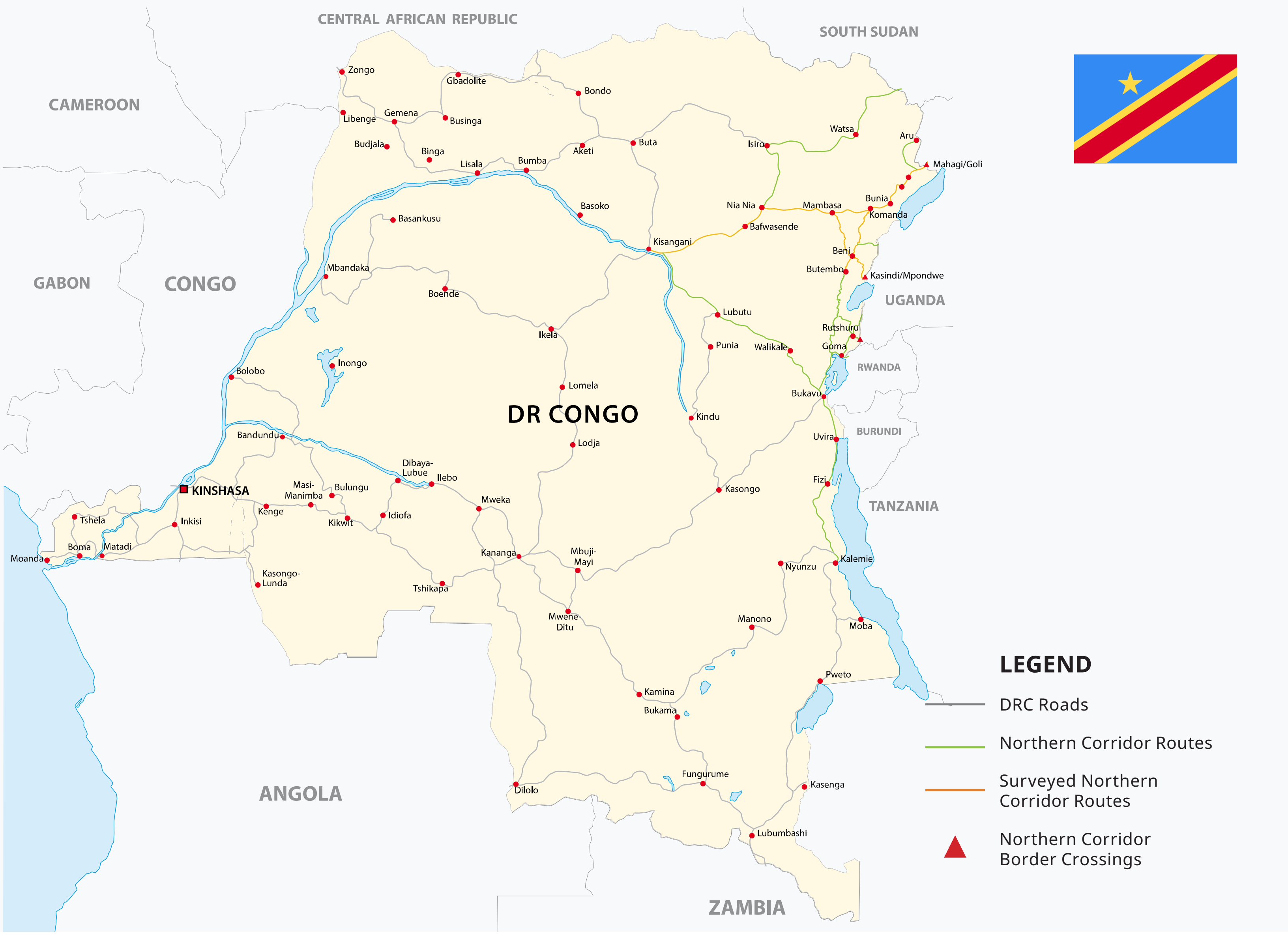
To achieve these mitigation targets, Burundi's NDC prioritizes the promotion of electric mobility, improvements in transport energy efficiency, and the development of public transport systems. The country is also developing legal and policy frameworks to support sustainable transport, including the adoption of cleaner vehicles. These efforts are reinforced by Burundi's National Climate Change Policy and Action Plan, which emphasize the mainstreaming of climate change responses across all sectors, including transport.

3.6.4 Pollutant Emissions

The estimated total quantity of pollutants for the freight transport sector along the Kobero – Gatumba route section in Burundi is 211.68 tonnes/year with the Northern Corridor section of Gitega – Gatumba contributing 139.46 tonnes/year. Overall, for Burundi, Nitrous Oxides (NOX) constitute 95% of all pollutants in quantity while Particulate Matter (PM10) constitutes 4% and Black Carbon (BC) approximately 1% as presented in the Figure 3 below.

Figure 3: Estimated Total Pollutant Emissions in Burundi





3.7 DRC

3.7.1 Average Daily Traffic in DRC

The analysis of daily traffic volumes in DRC provides critical insights into freight movement in and out of DRC through Uganda. An average daily traffic of 449 trucks was recorded at the survey stations. Table 14 presents the distribution of truck classes at different monitoring stations.

Table 13: Average Daily Traffic per Class per Station in DRC

Vehicle Class	Kasindi – Beni	Beni – Butembo	Goli – Bunia	Bunia – Kisangani	Bunagana – Goma	Total
LDT/ 2 – Axle	26	19	20	7	13	**85**
MCV – 3Axle	7	5	5	2	3	**22**
MCV – 4 Axle	4	3	3	1	2	**13**
HCV – 5 & 6 Axle	93	68	70	25	45	**301**
HCV – 7 & 8 Axle	9	6	7	2	4	**28**
HCV – >8 Axle	0	0	0	0	0	**0**
Total	**139**	**101**	**105**	**37**	**67**	**449**

The Kasindi – Beni route recorded the highest daily traffic (139 trucks), reflecting its strategic importance as a key transit corridor in the eastern DRC region.

Heavy Commercial Vehicles (HCV – 5 & 6 Axle and HCV – >8 Axle) dominate freight movement, making up 73% of the total traffic (329 trucks daily), reinforcing their critical role in long – haul and heavy – goods transport.

Light – Duty Trucks (LDT/2 – Axle) and Medium Commercial Vehicles (MCV – 3 Axle and 4 – Axle) account for 19% (85 trucks) and 8% (35 trucks) of traffic respectively, highlighting their supplementary role in regional and local distribution.

3.7.2 Traffic Distribution per Category

Table 15 provides a breakdown of truck distribution based on vehicle types.

Table 14: Traffic Distribution per Category in DRC

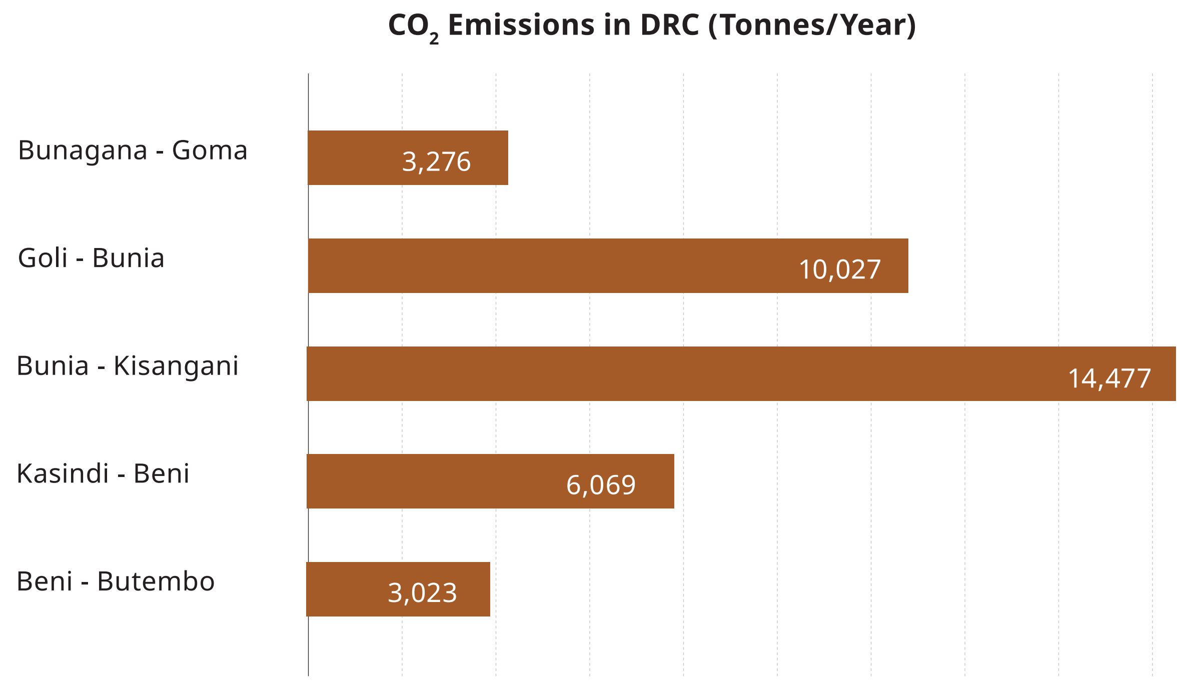
Vehicle Type	Daily Count
Box body truck	20%
Containerized truck	36%
Other	1%
Skeleton truck	12%
Tanker Truck	27%
Tipper	4%

Containerized trucks form the largest category vehicle type at 36%. Tankers were the second most common at 27% followed by Box body trucks at 20%, Skeletons, and tipper trucks were observed with varying low frequencies.

3.7.3 CO_2 Emissions per Road Section

The total estimated GHG emissions from road freight transport along the Northern Corridor surveyed route in DRC amounted to 0.03687 million tonnes of CO_2 equivalent ($MtCO_2e$). Bunia – Kisangani route is the predominant contributor, accounting for 39% (0.01448 $MtCO_2e$) of these emissions owing to its extensive length. While Beni – Butembo contributed the lowest emissions at 8% (0.003 $MtCO_2e$), together with the Kasindi – Beni route, they had the highest emission intensity relative to distance as shown in the Figure 4.

Figure 4: CO_2 Emissions per Route Section in DRC

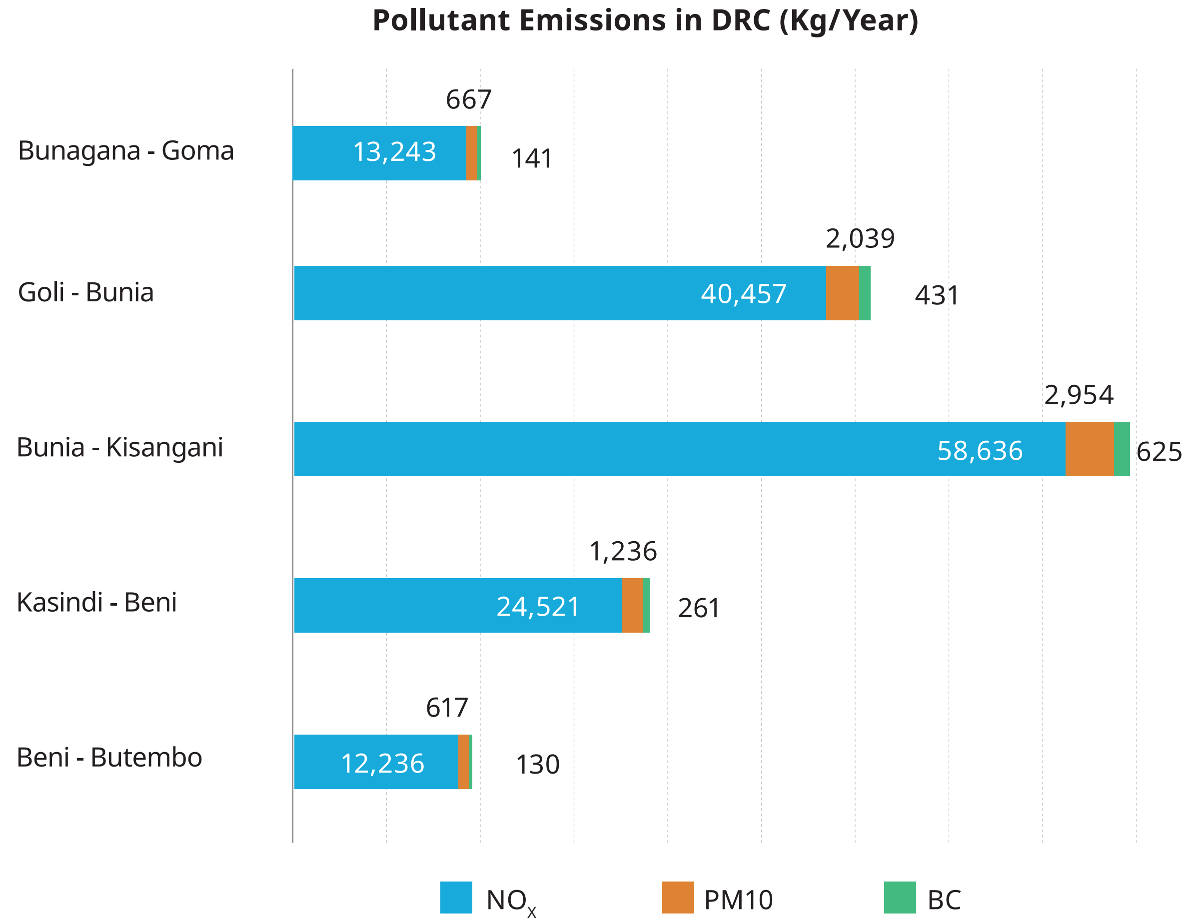


According to DRC's Updated Nationally Determined Contribution (2021), the energy sector, which includes transport, accounted for approximately 6.8 million tonnes of CO_2 equivalent ($MtCO_2e$) in 2015, representing a major portion of the national total. Under a Business – As – Usual (BAU) scenario, the DRC's total national emissions are projected to rise, from 69.6 $MtCO_2e$ in 2015 to 119.8 $MtCO_2e$ by 2030, driven by economic growth and the expansion of sectors like transport.

3.7.4 Pollutant Emissions

The estimated total quantity of pollutants in DRC is 91.769 tonnes/year distributed across Kasindi – Beni (59.5 tonnes/year) and Butembo – Beni (37.2 tonnes/year). For all the routes, Nitrous Oxides (NOX) constitute over 94% of all pollutants in quantity as shown in Figure 5.

Figure 5: Estimated Total Pollutant Emissions in DRC



This 2024/2025 baseline survey, which quantifies road freight emissions along the Northern Corridor in the DRC indicates that the Bunia – Kisangani route is the highest pollution contributor, accounting for 39% of total pollutants emissions, followed by the Goli – Bunia route at 27%, with pollutants totaling 105 tonnes/year. The high levels of Nitrous Oxide (NOx) emissions recorded in major routes highlight the need for a rapid transition to low – emission alternatives, particularly in freight transport.

The DRC has committed to a 19% reduction of its emissions by 2030 conditional on receiving adequate financial, technical and capacity building support, and 2% unconditional reduction compared to the BAU scenario. Key mitigation measures outlined in DRC's NDC to achieve this in the transport sector include promoting vehicle renewal, improving the energy efficiency of the vehicle fleet, and developing mass transit systems.

3.8 Kenya

3.8.1 Average Daily Traffic in Kenya

Kenya's movement of goods and people to facilitate economic activities takes place by road, rail, air or water. Seventy – six percent (76%) of freight is transported through the road subsector according to Kenya Roads Board.

Based on the truck traffic at the survey stations, the survey sampled trucks per vehicle class in Kenya as summarized in Table 17.

Table 15: Average Daily Traffic per Class per Station in Kenya

Vehicle Class	Athi River	Busia	Gilgil	Mariakani	Webuye	Total
LDT / 2-Axle	2,101	409	1,000	520	176	**4,206**
MCV – 3 Axle	784	25	152	64	40	**1,065**
MCV – 4 Axle	41	5	16	65	4	**131**
HCV – 5 & 6 Axle	2,153	597	2,630	3,333	1,397	**10,110**
HCV – 7 & 8 Axle	20	5	10	14	9	**58**
HCV – >8 Axle	3	5	2	2	1	**13**
Total	**5,102**	**1,046**	**3,810**	**3,998**	**1,627**	**15,583**

SOUTH SUDAN
ETHIOPIA
UGANDA
KENYA
SOMALIA
TANZANIA
Lokichoggio
Lodwar
Moyale
Mandera
El Wak
Marsabit
Wajir
Habaswein
Kitale
Malaba
Busia
Bungoma
Eldoret
Kakamega
Isiolo
Meru
Nyahururu
Nanyuki
Kisumu
Rongai
Nakuru
Molo
Kericho
Homa Bay
Nyeri
Embu
Garissa
Kisii
Naivasha
Mwingi
Migori
Narok
Thika
Ruiru
Isebania
NAIROBI
Machakos
Lamu
Namanga
Malindi
Taveta
Kilifi
Mombasa
Lunga Lunga
LEGEND
Kenya Roads
Northern Corridor Routes
Surveyed Northern Corridor Routes
Northern Corridor Border Crossings

3.8.2 Traffic Distribution per Category

The distribution of truck traffic in Kenya demonstrates a high reliance on containerized and box body trucks, which collectively account for most of the freight movement. Table 18 presents the distribution of different vehicle types along the corridor.

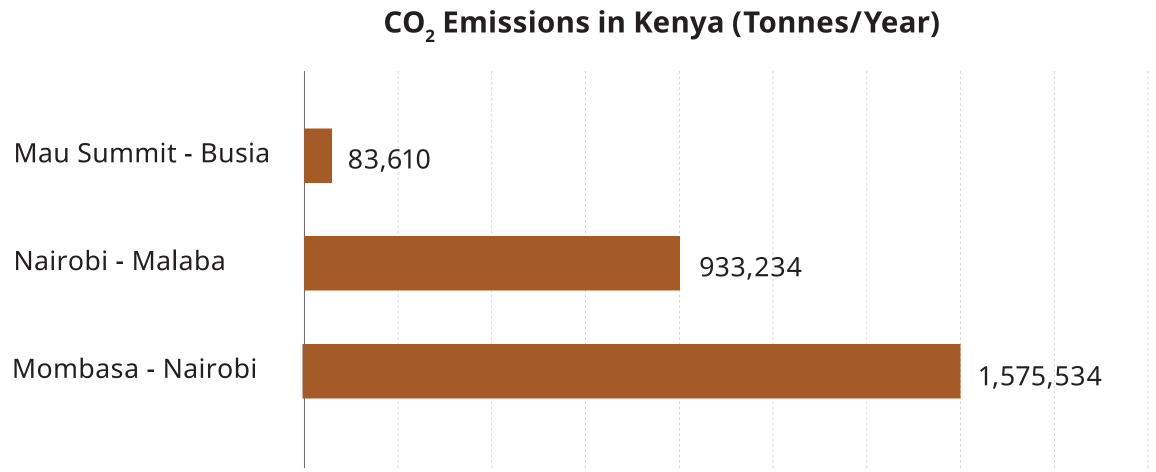
Table 16: Traffic Distribution per Category in Kenya

Vehicle Type	Daily Count
Box body truck	20%
Containerized truck	36%
Other	1%
Skeleton truck	12%
Tanker Truck	27%
Tipper	4%

3.8.3 CO_2 Emissions per Road Section

Based on the GHG emission calculation methodology employed and the route sections covered, the estimate GHG emissions for the Mombasa – Nairobi is 1.58 $MtCO_2e$, 0.93 $MtCO_2e$ for Nairobi – Malaba and 0.084 $MtCO_2e$ for the Mau Summit – Busia route section as shown in the Figure 6.

Figure 6: CO_2 Emissions per Road Section in Kenya



Kenya's Nationally Determined Contributions (NDC) report for the transport sector includes a goal to reduce carbon dioxide equivalent ($MtCO_2e$) emissions by 3.46 $MtCO_2e$ by 2030. This goal is part of a broader commitment to lower GHG emissions by 32% by 2030 relative to the business – as – usual scenario of 143 $MtCO_2e$.

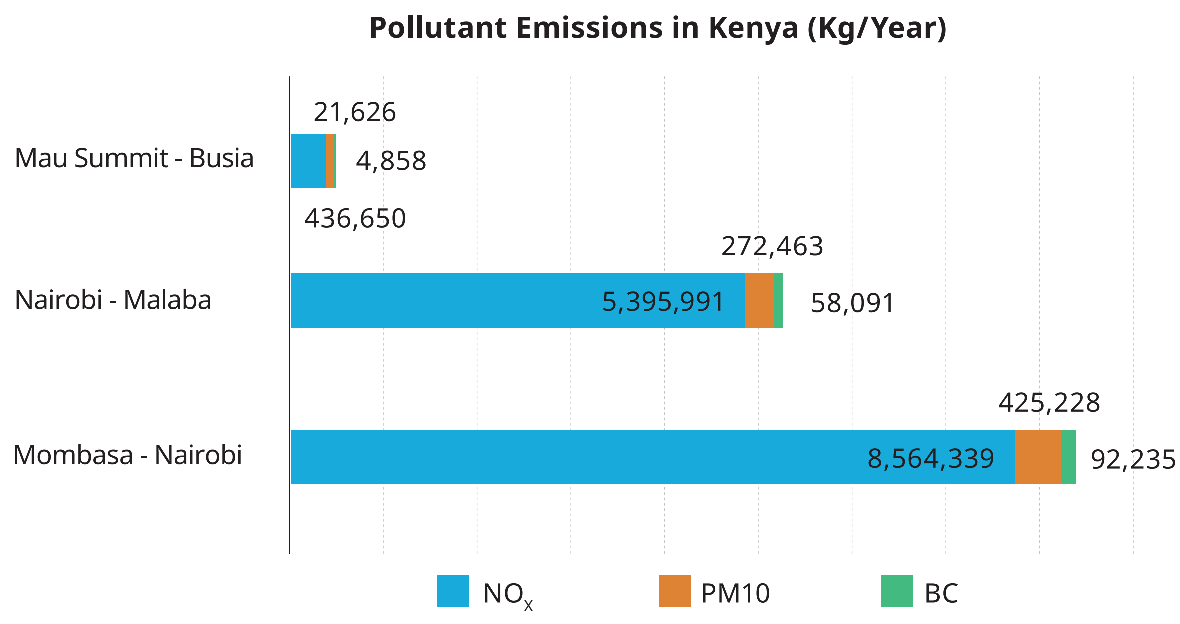
Kenya has acknowledged the importance of addressing climate change. As a signatory of the Paris Agreement, Kenya enacted its Climate Change Act in 2016. The act highlights the importance of mainstreaming climate change across all sectors and developing a National Climate Change Action Plan to implement climate change action.

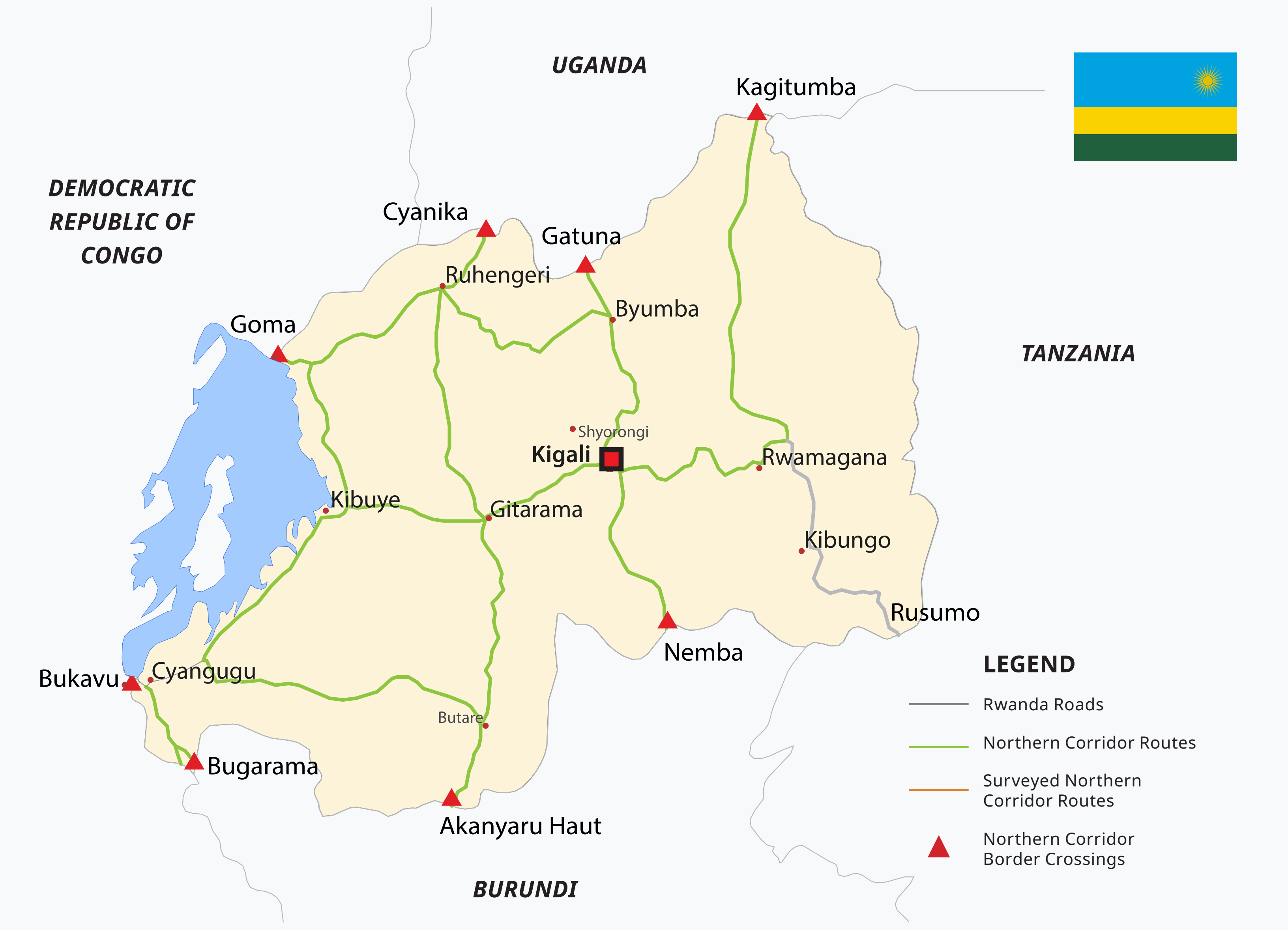
Kenya's NDC commits to Kenya has also put measures in place to promote the shift of passenger and freight from road to rail. The country is also in the process of developing legal and policy frameworks to promote the use of electric vehicles.

3.8.3 Pollutant Emissions

The estimated total quantity of pollutants for the freight transport sector along the Northern Corridor surveyed route in Kenya is 15,271.5 tonnes/year. The Mombasa – Nairobi route section contributes 9,081.8 tonnes/year, Nairobi – Malaba 5,276.5 tonnes/year, and Mau Summit – Busia 463.1 tonnes/year. Overall, for Kenya, Nitrous Oxides (NOX) constitute 94% of all pollutants in quantity while Particulate Matter (PM10) constitutes 5% and Black Carbon (BC) approximately 1% as presented in the Figure 7.

Figure 7: Estimated Total Pollutant Emissions in Kenya





3.9 Rwanda

3.9.1 Average Daily Traffic in Rwanda

The analysis of daily traffic volumes in Rwanda provides critical insights into freight movement along major transport corridors.

Rwanda recorded an average daily traffic (ADT) of 3,764 trucks, the lowest among the three countries, reflecting its smaller geographic scope and focus on regional distribution. Table 20 presents the distribution of truck classes at different monitoring stations.

Table 17: Average Daily Traffic per Class per Station in Rwanda

Vehicle Class	Musanze – Kigali	Kigali – Huye	Rubavu Border	Huye – Rusizi	Gatuna Border	Cyanika Border	Total
LDT / 2-Axle	270	738	120	362	30	255	**1,775**
MCV – 3 Axle	73	552	165	68	18	39	**914**
MCV – 4 Axle	15	23	20	14	3	9	**84**
HCV – 5 & 6 Axle	132	183	135	109	177	114	**850**
HCV – 7 & 8 Axle	33	13	67	7	7	6	**133**
HCV – >8 Axle	1	1	3	1	1	1	**8**
Total	**524**	**1,510**	**510**	**561**	**236**	**424**	**3,765**

The Kigali – Huye route recorded the highest daily traffic (1,510 trucks), reflecting its strategic importance in domestic and regional trade.

LDT/2 – Axle trucks dominate freight movement, making up 47% of the total traffic (1,775 trucks daily), highlighting the reliance on smaller commercial vehicles for cargo distribution.

Heavy Commercial Vehicles (HCV – 5&6 Axle) account for 22.6% of total truck movement (850 trucks daily), reinforcing their role in long – haul transport.

Cross – border stations such as Rubavu and Gatuna have lower daily traffic volumes, indicating more localized freight distribution and reduced heavy freight movement across borders.

3.9.2 Traffic Distribution per Category

Table 21 provides a breakdown of truck distribution based on vehicle types.

Table 18: Traffic Distribution per Category in Rwanda

Vehicle Type	Daily Count
Box body truck	751
Containerized truck	515
Other	38
Skeleton truck	474
Tanker Truck	182
Tipper	1799

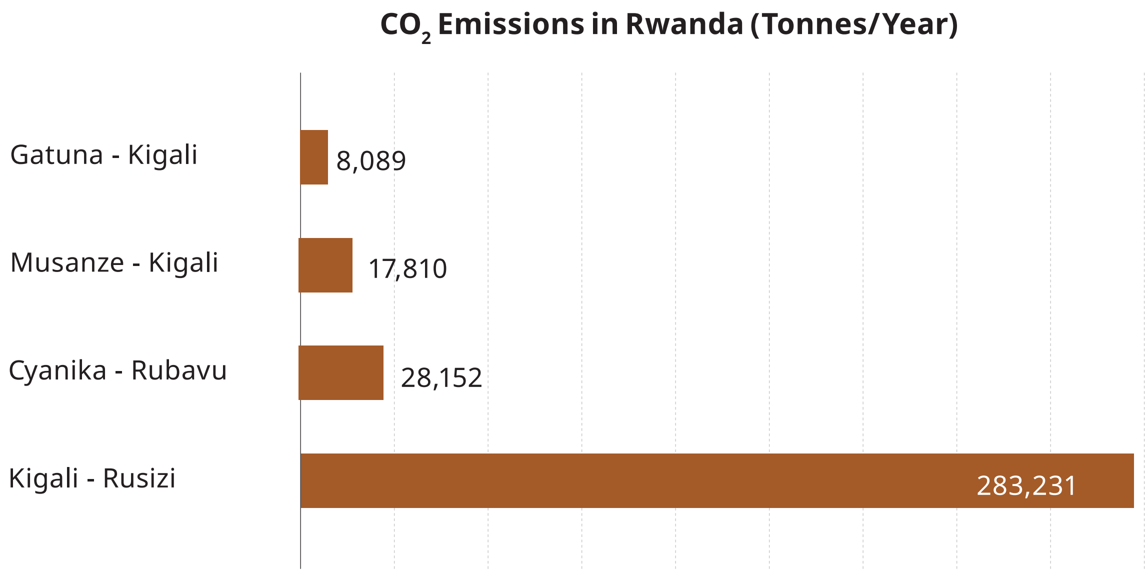
Tipper trucks (1,799 daily) form the largest category, followed by box body trucks (751 daily) and containerized trucks (515 daily).

Skeleton trucks (474 daily) highlight the importance of containerized freight, while the tanker truck segment (182 daily) is relatively small.

Tipper trucks (1,799 daily) lead, supporting construction and local goods transport, followed by box body (751 daily) and containerized trucks (515 daily), aligning with Rwanda's domestic freight focus.

The total estimated GHG emissions from road freight transport along the Northern Corridor in Rwanda amount to 0.34 million tonnes of CO_2 equivalent ($MtCO_2e$). The Kigali – Rusizi route is the predominant contributor, accounting for 84% (0.28 $MtCO_2e$) of these emissions, highlighting it as a critical area for intervention. Other routes such as Cyanika – Rubavu contribute 8% (0.03 $MtCO_2e$), Musanze – Kigali accounts for 5% (0.02 $MtCO_2e$), and Gatuna – Kigali contributes 2% (0.01 $MtCO_2e$) as shown in the Figure 8.

Figure 8: Emissions per Road Section in Rwanda



According to Rwanda's Updated Nationally Determined Contribution (NDC) 2020, the transport sector contributed 0.69 $MtCO_2e$ in 2015, reflecting 13% of the total national GHG emissions. Rwanda has committed to a 38% reduction in GHG emissions by 2030 relative to the business – as – usual scenario, with transport being a significant sector in achieving these targets.

The transport sector in Rwanda significantly contributes to greenhouse gas (GHG) emissions, driven by its reliance on diesel – powered road freight, which accounted for approximately 0.69 $MtCO_2e$ in 2015 (13% of national emissions; Rwanda NDC, 2020).

Under a Business – As – Usual (BAU) scenario, total emissions are projected to rise from 5.3 $MtCO_2e$ in 2015 to 12.1 $MtCO_2e$ by 2030 due to economic growth and transport expansion.

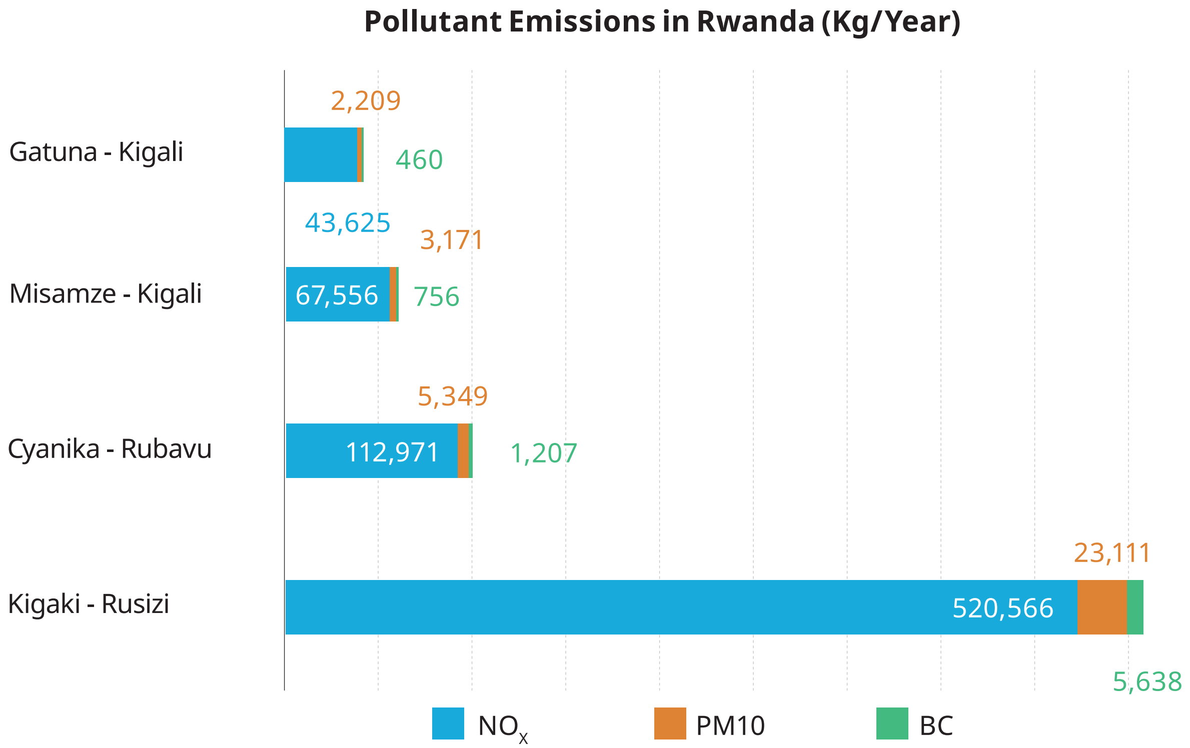
This 2024 baseline survey quantifies road freight emissions along the Northern Corridor in Rwanda at 0.34 $MtCO_2e$, with pollutants totaling 786.6 tonnes/year, providing a foundation for Rwanda's target of a 38% reduction (4.6 $MtCO_2e$) by 2030 through measures like electrification and public transit improvements.

3.9.3 Pollutant Emissions

The estimated total quantity of pollutants along the surveyed route in Rwanda is 786.6 tonnes/year distributed across Cyanika – Rubavu (119.5 tonnes/year), Musanze – Kigali, (71.5 tonnes/year), Gatuna – Kigali (46.3 tonnes/year) and Kigali – Rusizi (549.3 tonnes/

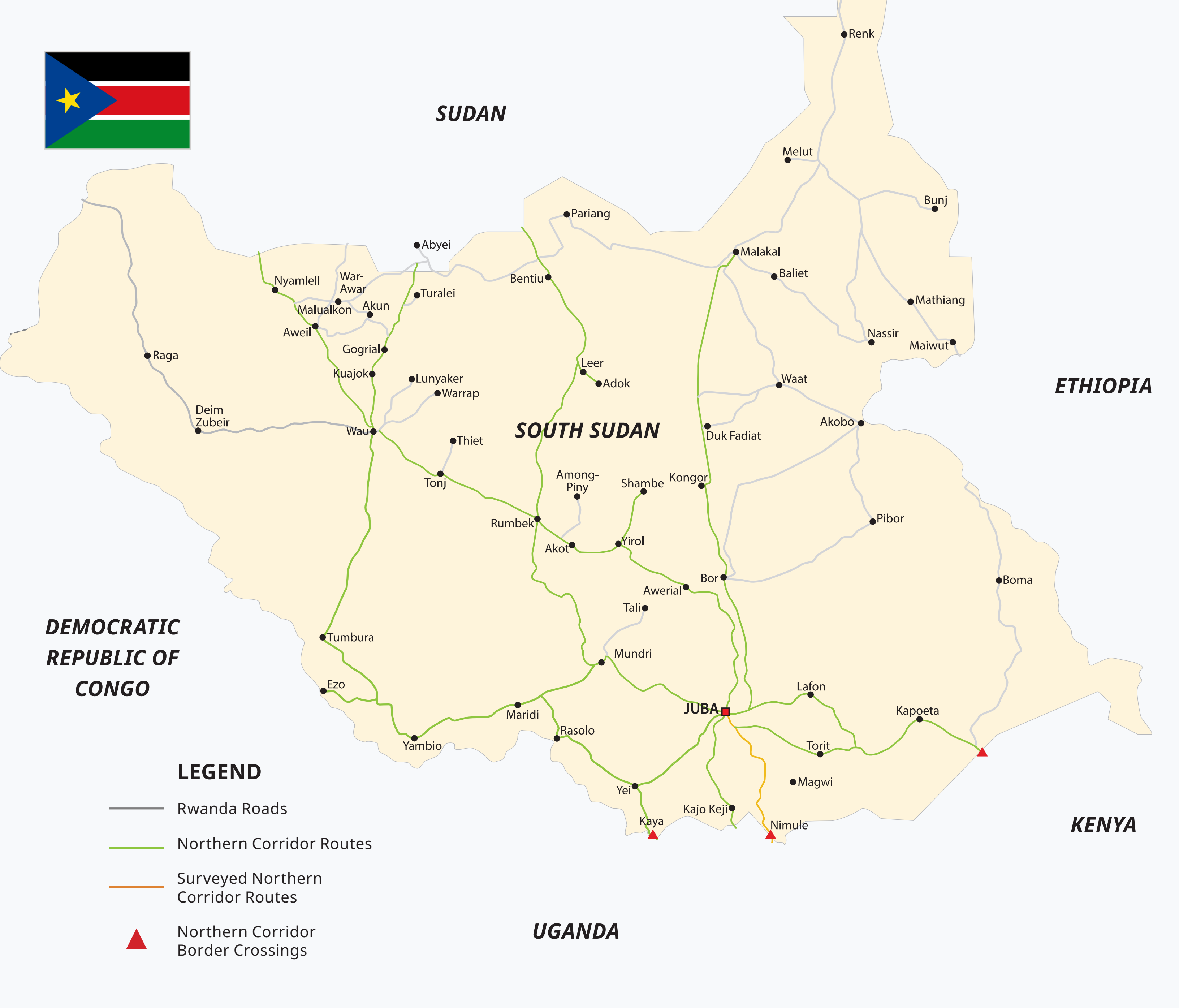
year). For all the routes, Nitrous Oxides (NOX) constitute over 94% of all pollutants in quantity as shown in the Figure 9 below.

Figure 9: Estimated Total Pollutant Emissions in Rwanda



Data indicates that the Kigali – Rusizi route has the highest GHG emission accounting for nearly 70% of total pollutants emissions, followed by the Cyanika – Rubavu and Musanze – Kigali routes. The high levels of Nitrous Oxide (NOx) emissions recorded in major routes highlight the need for a rapid transition to low – emission alternatives, particularly in freight transport.

To meet these targets, Rwanda must implement strategic interventions aimed at curbing transport – related emissions. For freight transport, this includes promoting electric vehicles (EVs) / freight trucks while expanding charging infrastructure to support their adoption. Stricter fuel quality and emissions regulations are essential, including the introduction of biofuels and compressed natural gas (CNG) as cleaner alternatives to diesel. Additionally, stronger vehicle inspection and maintenance programs will help phase out older, high – emission vehicles, while dedicated freight lanes and smart traffic management systems can further enhance fuel efficiency.



3.10 South Sudan

The road transport sector in South Sudan is the main mode of transportation, accounting for nearly all internal freight and passenger movement. The sector is a significant contributor to South Sudan's greenhouse gas (GHG) emissions, The poor road conditions in South Sudan exacerbates fuel inefficiency and as a result higher emission levels for equivalent distance. Nimule – Juba route in the busiest Northern Corridor route into South Sudan through Uganda.

3.10.1 Average Daily Traffic in South Sudan

The survey captured truck movement along the Nimule – Juba route of the Northern Corridor, with average daily truck counts as shown in Table 23 below:

Table 19: Average Daily Traffic per Class per Station in South Sudan

Vehicle Class	Nimule – Juba
LDT/ 2 – Axle	107
MCV – 3Axle	81
MCV – 4 Axle	15
HCV – 5 & 6 Axle	647
HCV – 7 & 8 Axle	36
HCV – >8 Axle	2
Total	**888**

From the tally, HCV – 5 & 6 Axle vehicle class dominated the route mainly composed of cross – border truck traffic while LDT/ 2 – Axle served the local supply chain.

3.10.2 Traffic Distribution per Category

Truck movements in South Sudan are dominated by containerized trucks and tankers, which together accounted for 58% of all truck traffic. The distribution by vehicle type is as follows in Table 24:

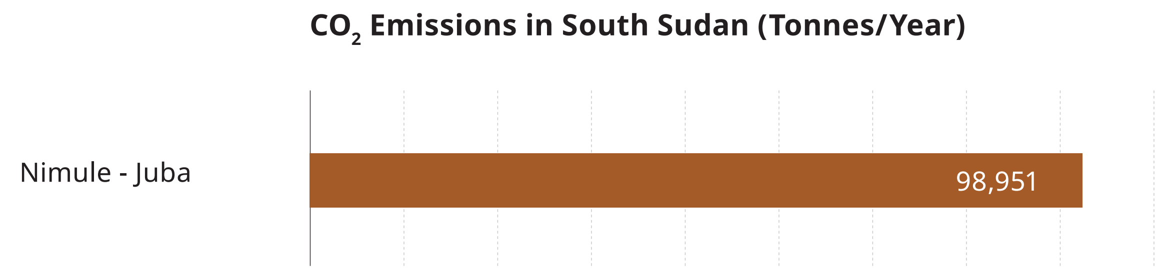
Table 20: Traffic Distribution per Category in South Sudan

Vehicle Type	Daily Count
Box Body Truck	140
Containerized Truck	333
Skeleton Truck	159
Tanker Truck	186
Tipper	70
Other	0

3.10.3 CO_2 Emissions per Road Section

The total estimated greenhouse gas (GHG) emissions from road freight transport along the surveyed route of the Northern Corridor in South Sudan amount to 0.098951 million metric tons of CO_2 equivalent ($MtCO_2e$) as illustrated in the Figure 10.

Figure 10: CO_2 Emissions per Road Section in South Sudan

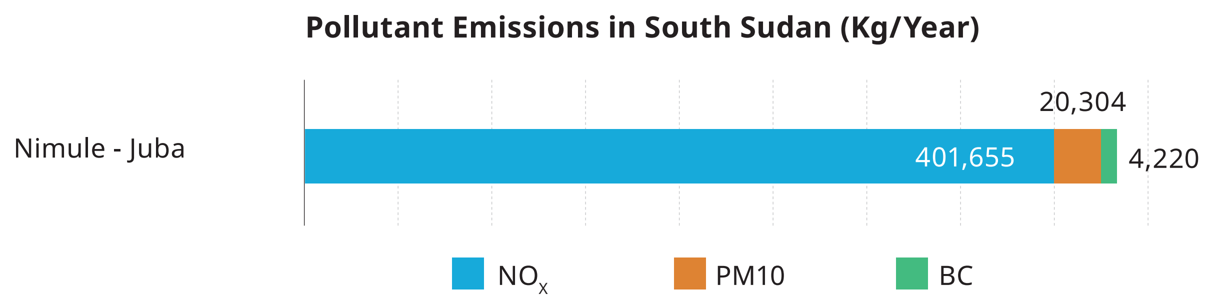


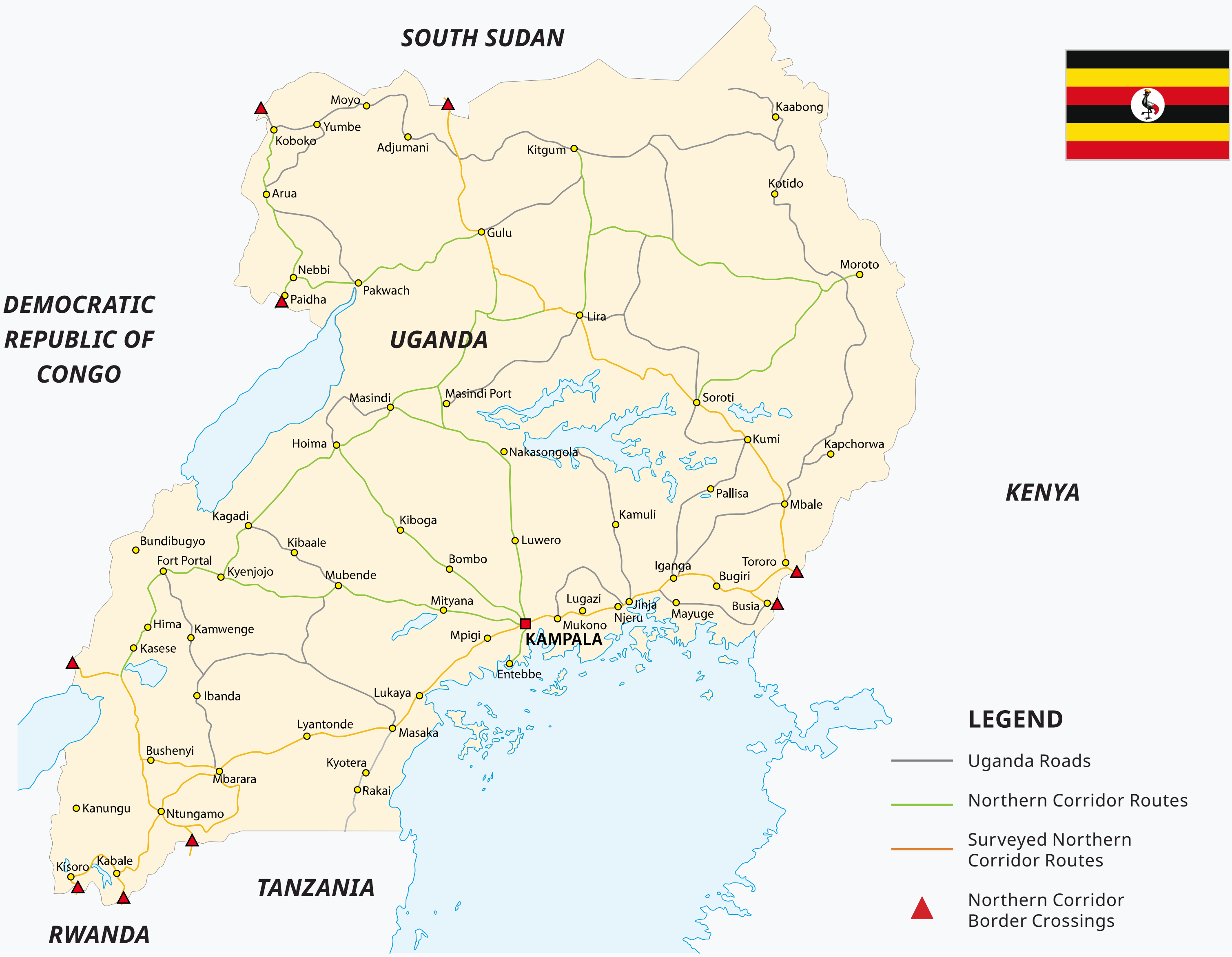
South Sudan, through its updated NDC, targets to reduce GHG emissions from the transport sector by 44% to 0.5 $MtCO_2e$ from a projected 0.9 $MtCO_2e$ in 2030 under case of no action scenario. To achieve this, the NDC has proposed promoting the use of low – carbon transport technologies, such as electric vehicles (EVs), and the regulation of inefficient vehicle imports to curb emissions and air pollution. (South Sudan NDC 2022).

3.10.4 Pollutant Emissions

The estimated total quantity of pollutants from road freight transport along the surveyed route in South Sudan is 426.179 tonnes/year. In terms of pollutants category, Nitrous Oxides (NOX) constituted over 94% of all pollutants in quantity as shown in the Figure 11 below.

Figure 11: Estimated Total Pollutant Emissions in South Sudan





3.11 Uganda

The road transport sector in Uganda is the dominant mode of transportation, accounting for over 95% of total freight and passenger traffic (BMAU, 2022). The transport sector remains a dominant contributor to Uganda's greenhouse gas (GHG) emissions, with road transport alone accounting for 84% of total transport energy consumption. This figure far exceeds that of domestic aviation (11%) and rail and water transport (3%), highlighting the country's reliance on road – based freight and passenger transport (Uganda Updated NDC 2022). The heavy dependence on fossil fuel – powered vehicles contribute significantly to rising emissions, particularly in urban centers and along major trade corridors. As Uganda continues to expand its road network and vehicle ownership rates increase, the sector's carbon footprint is expected to rise sharply if no mitigation measures are put in place.

Projections indicate that, under a Business – As – Usual (BAU) scenario, emissions from Uganda's transport sector will more than double from 4.2 $MtCO_2e$ in 2015 to 9.6 $MtCO_2e$ by 2030. This escalation underscores the urgent need for low – carbon transport interventions to curb emissions growth. In response, Uganda has committed to an ambitious 24.7% reduction below the BAU scenario by 2030 under its Nationally Determined Contribution (NDC) targets. If the proposed mitigation measures are fully implemented, the sector's emissions could be limited to 6.8 $MtCO_2e$, marking a 29% reduction from the projected BAU scenario. Achieving these targets will require a strategic shift toward fuel – efficient and alternative energy transport solutions, including electrification of mobility, enhanced public transit systems, and improved fuel efficiency regulations. Additionally, investments in rail and water – based transport alternatives could help reduce road transport dependency, further contributing to Uganda's climate goals while promoting economic sustainability.

3.11.1 Average Daily Traffic in Uganda

The survey captured truck movement at various monitoring stations, with total daily truck counts recorded as follows in Table 26 below:

Table 21: Average Daily Traffic per Class per Station in Uganda

Vehicle Class	Lukaaya	Magamaga	Malaba	Mbale	Mbarara	Mpondwe	Total
LDT/2 – Axle	733	683	7	201	168	160	**1,953**
MCV – 3 Axle	112	120	4	40	83	44	**401**
MCV – 4 Axle	47	90	1	19	19	12	**189**
HCV – 5&6 Axle	543	1,966	1,069	800	279	118	**4,775**
HCV – 7&8 Axle	22	27	11	16	13	32	**121**
HCV – >8 Axle	0	2	0	0	0	1	**4**
Total	**1,458**	**2,889**	**1,093**	**1,076**	**561**	**367**	**7,443**

3.11.2 Traffic Distribution per Category

Truck movements in Uganda are dominated by box body trucks and containerized trucks, which account for 73% of all truck traffic. The distribution by vehicle type is as follows in Table 27:

Table 22: Traffic Distribution per Category in Uganda

Vehicle Type	Daily Count
Box Body Truck	2,361
Containerized Truck	2,167
Skeleton Truck	741
Tanker Truck	986
Tipper	1,126
Other	53

The high presence of containerized and box body trucks underlines Uganda's dependence on imports and exports via road transport, a sector identified in the NDC as critical for emissions reduction through improved vehicle efficiency and modal shift strategies.

3.11.3 CO_2 Emissions per Road Section

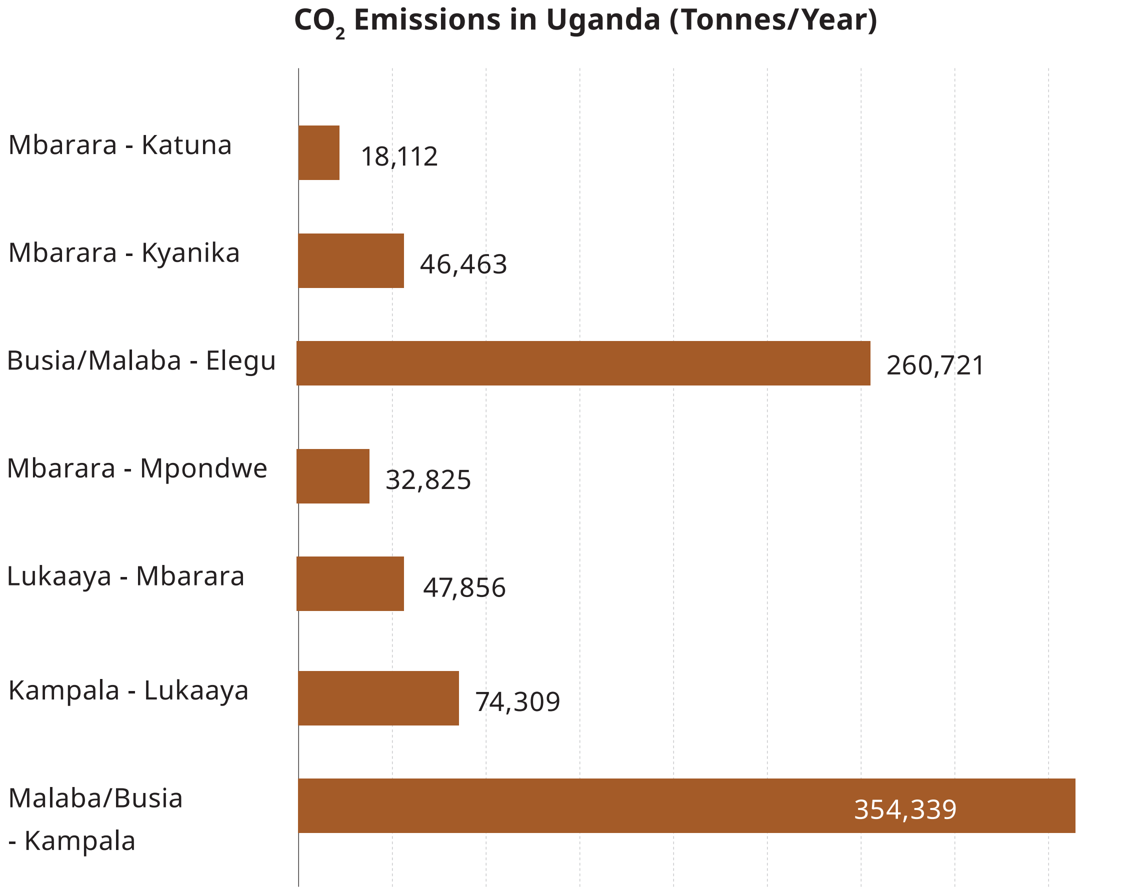
The total estimated GHG emissions from road freight transport along the Northern Corridor in Uganda amount to 0.83 $MtCO_2e$ as illustrated in the figure below.

The distribution of emissions across key road sections is as follows:

- Malaba/Busia – Kampala: 0.35 $MtCO_2e$ (42% of total emissions)
- Busia/Malaba – Elegu: 0.26 $MtCO_2e$ (31%)
- Kampala – Lukaya: 0.07 $MtCO_2e$ (9%)
- Lukaaya – Mbarara: 0.05 $MtCO_2e$ (6%)
- Mbarara – Cyanika: 0.05 $MtCO_2e$ (6%)
- Mbarara – Mpondwe: 0.03 $MtCO_2e$ (4%)
- Mbarara – Katuna: 0.02 $MtCO_2e$ (2%)

The Malaba/Busia – Kampala and Busia/Malaba – Elegu corridors together contribute 73% of the total emissions, highlighting these as critical areas for targeted interventions to achieve significant emissions reductions.

Figure 12: CO_2 Emissions per Road Section in Uganda



Uganda's updated Nationally Determined Contributions (NDC) outlines ambitious mitigation targets for the transport sector, aiming for a 29% reduction in GHG emissions by 2030 compared to a business – as – usual (BAU) scenario. This equates to limiting transport emissions to 6.8 $MtCO_2e$ by 2030, down from a projected 9.6 $MtCO_2e$ under BAU conditions

Key commitments relevant to reducing road freight emissions along the Northern Corridor include:

- **Rehabilitation of 634 km of meter gauge railway (MGR)** by 2026 to facilitate a modal shift from road to rail for freight, which is more energy – efficient. This is expected to improve diesel locomotive fuel economy by 22% by 2030.
- **Implementation of 1,412 km of fully electrified standard gauge rail (SGR)** by 2050, which, although a longer – term measure, will significantly reduce reliance on road freight in the future.

- **Fuel Efficiency Improvements:** The Global Fuel Economy Initiative (GFEI) targets a 20% improvement in fuel efficiency for road transport by 2030.
- **Alternative Fuel Adoption:** A 1% annual increase in alternative fuel use for road vehicles, with 60% from natural gas, 20% from ethanol (E10), and 20% from biodiesel.

Given the emissions profile and NDC targets, the following strategies are recommended to reduce GHG emissions along the Northern Corridor sections in Uganda:

- **Modal Shift from Road to Rail:** Prioritizing the transition of freight from high – emission road sections, particularly Malaba/Busia – Kampala, to rail through expedited completion of SGR and MGR projects.
- **Fuel Efficiency and Alternative Fuels:** Encouraging the adoption of fuel – efficient freight vehicles and promoting the use of natural gas, biodiesel, and ethanol blends. Policies to regulate the import of older, less fuel – efficient vehicles should also be reinforced.
- **Optimizing Freight Logistics:** Implementing logistics optimization tools and practices to reduce empty trips and improve load factors, especially on high – emission routes like Busia/Malaba – Elegu.
- **Infrastructure Improvements:** Upgrading road infrastructure to reduce congestion and improve fuel efficiency, particularly on the Kampala – Lukaya and Lukaya – Mbarara segments.

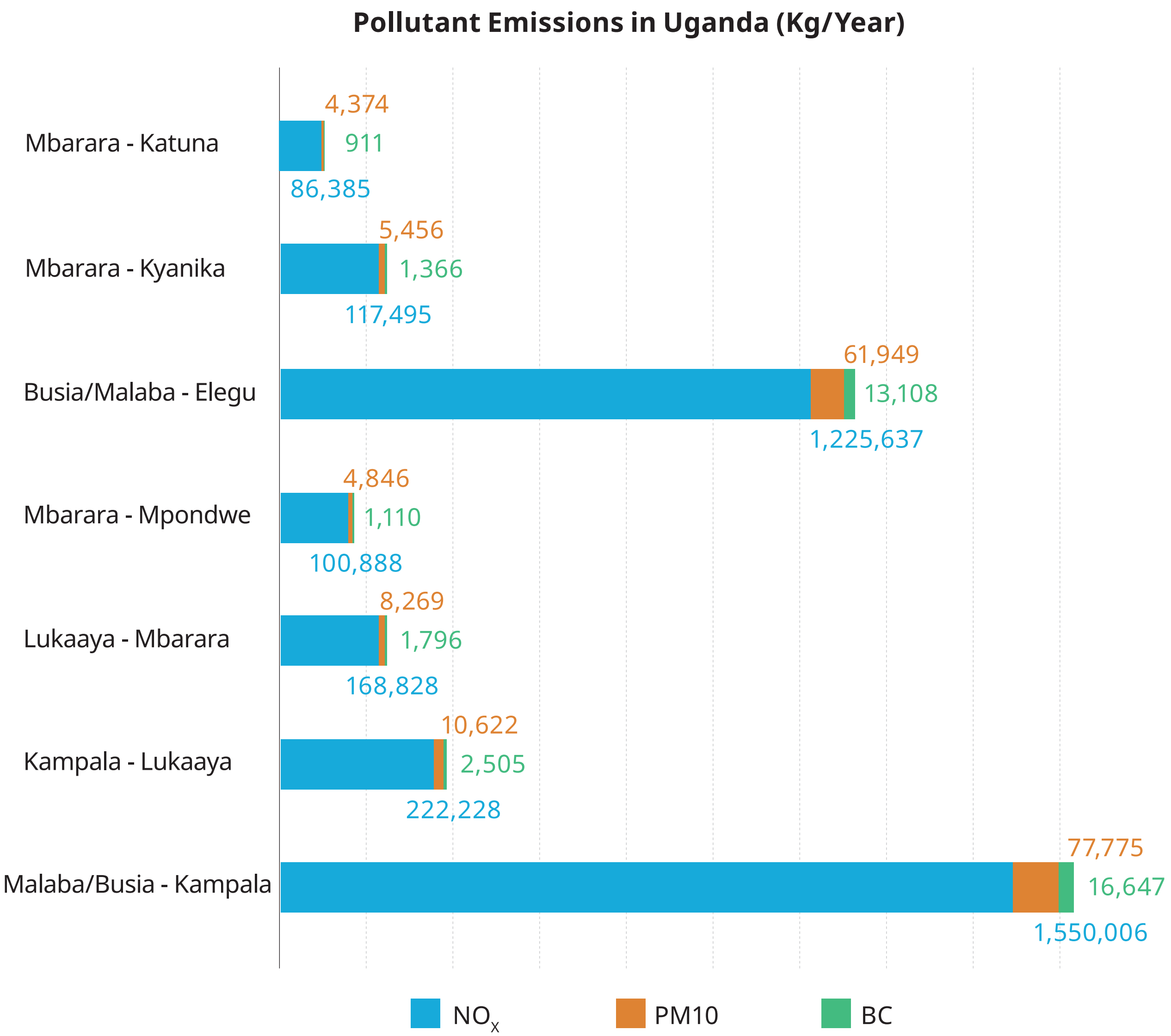
If fully implemented, Uganda's NDC strategies could result in a significant reduction in road freight emissions along the Northern Corridor. Assuming proportional benefits across major road sections:

- A 20% fuel efficiency improvement could reduce emissions from Malaba/Busia – Kampala by 0.07 $MtCO_2e$, lowering its contribution to 0.28 $MtCO_2e$.
- The modal shift to rail could potentially reduce emissions on the Busia/Malaba – Elegu route by 30%, decreasing emissions from 0.26 $MtCO_2e$ to approximately 0.18 $MtCO_2e$.
- Combined, these interventions could reduce the total corridor emissions from 0.83 $MtCO_2e$ to approximately 0.62 $MtCO_2e$, contributing significantly towards Uganda's 2030 transport sector goals.

3.11.4 Pollutant Emissions

The estimated total quantity of pollutants from road freight transport along the surveyed routes in Uganda is 3,682.2 tonnes/ year. Out of this, 80% of the pollutants were contributed by Malaba/Busia – Kampala 1,644.4 tonnes/year (45%) and Busia/ Malaba – Elegu 1,300.7 tonnes/year (35%) route sections. Other sections contributed as follows; Kampala – Lukaya 235.4 tonnes/year (6%), Lukaya – Mbarara 178.9 tonnes/year (5%), Mbarara – Mpondwe 106.8 tonnes/year (3%), Mbarara – Cyanika 124.3 tonnes/ year (3%) and Mbarara – Katuna 91.7 tonnes/year (2%). In terms of pollutants category, Nitrous Oxides (NOx) constituted over 94% of all pollutants in quantity as shown in the Figure 13 below.

Figure 13: Estimated Total Pollutant Emissions in Uganda



4 Conclusion and Recommendations

4.1 Conclusion

The 2024/2025 GHG Emissions Baseline provides a comprehensive, data-driven assessment of freight-related emissions along the Northern Corridor. The baseline survey analyzed 29,172 daily truck movements across 24 monitoring stations and a stratified sample of 5,334 vehicles, establishing a corridor-wide baseline of approximately 3.96 million tonnes of CO_2 equivalent ($MtCO_2e$) and about 20,298 tonnes of air pollutants (NO_x, PM_{10} and black carbon) per year.

Country-level GHG emissions were estimated at 0.062 $MtCO_2e$ for Burundi, 0.037 $MtCO_2e$ for the Democratic Republic of Congo, 2.59 $MtCO_2e$ for Kenya, 0.34 $MtCO_2e$ for Rwanda, 0.099 $MtCO_2e$ for South Sudan, and 0.83 $MtCO_2e$ for Uganda, with the spatial distribution of pollutant emissions closely mirroring that of CO_2 emissions. Kenya, Uganda, and Rwanda together account for the overwhelming majority of both GHG and pollutant emissions, reflecting their high freight volumes and strategic roles in regional trade.

The findings confirm that road freight transport – dominated by heavy commercial vehicles (approximately 61% of traffic) operating on long-haul corridor sections – is a major source of emissions. High levels of empty running (about 45%), ageing vehicle fleets in several countries, variable fuel consumption, and limited availability of lower-carbon transport alternatives significantly increase emissions intensity across the corridor.

Corridor emissions were high along Mombasa – Nairobi, Nairobi – Malaba, Kigali – Rusizi, Malaba/Busia – Kampala, and Bunia – Kisangani route sections indicating where targeted interventions can deliver rapid, high – impact reductions. Pollutant emissions are NOx – dominant (>94%), pointing to long – standing diesel reliance and outdated engine technologies. Additionally, fuel efficiency improves when trucks run empty, performing no freight – moving work. The results provide insights into possible mitigation potential areas through fuel – efficiency improvement measures, cleaner technologies, and modal shift aligned with Member States' NDC commitments of achieving 22% CO_2 reduction for Burundi, 21% for DRC, 32% for Kenya, 38% for Rwanda, 44% for South Sudan and 29% for Uganda by 2030.

This baseline therefore provides a reference point for measuring future improvements, guiding investment priorities, and tracking the implementation of the Northern Corridor Green Freight Strategy 2030 that targets a 10% CO_2 intensity reduction by 2030 and net – zero emissions by 2050. It establishes the evidence base needed to advance a low – carbon, efficient, and competitive freight system that supports regional integration while reducing environmental and public – health impacts.

4.2 Recommendations

To achieve the Northern Corridor Green Freight Strategy 2030's targets of a 10% CO_2 intensity reduction by 2030, reduce the particulate matter(PM). Black Carbon and oxides of Nitrogen(N0x) by 12% by 2030 and net–zero emissions by 2050, the following recommendations are proposed:

a) **Promote Eco – Driving and Operational Efficiency:**

i) Create awareness and sensitization campaigns on Ghg Emissions in all Northern Corridor Member States.

ii) Conduct eco–driving training for fleet operators and owners, and truck drivers to optimize fuel consumption, reduce emissions, and enhance safety through techniques like proper acceleration, braking, and route planning.

iii) Incorporate eco–driving in national HDV driver training curriculum and programs.

iv) Introduce Annual eco–driver certification for trucking companies.

b) Policy Harmonization on Vehicle Emission Standards and Regulation

i) Adopt and implement Euro 4/IV vehicle emission standards across all Northern Corridor member states to reduce NO_x, PM10, and BC emissions from diesel trucks.

ii) Establish uniform vehicle age limits for imported second – hand trucks across all Northern Corridor member states to prevent the entry of inefficient, and high – emission vehicles,

iii) Member States to adopt mandatory emissions testing as part of annual licensing requirements for heavy – duty vehicles (HDVs).

c) Promoting Green Freight Technologies:

i) Support pilot projects for alternative fuel vehicles (electric, LNG, hydrogen – powered trucks, and biofuels)

ii) Offer incentives like tax breaks or subsidies for fleet owners adopting cleaner technologies.

iii) Encourage retrofitting existing truck fleets with fuel – saving technologies, such as improved exhaust systems and energy – efficient engines, to lower emissions.

d) Enhancing Fuel Quality and Efficiency

i) Member States enforce strict adherence to fuel standards to reduce particulate matter and black carbon emissions which support air quality improvements.

ii) Member States to promote exports and cargo consolidation where exporters combine smaller shipments into full truck loads to maximize truck capacity, reduce empty trips, and improve fuel efficiency.

e) Promoting Modal Shift to Lower – Carbon Transport

i) Member States to enhance railway networks and connectivity.

ii) Kenya and Uganda to prioritize Railway rehabilitation.

iii) Kenya to prioritize Standard Gauge Railway (SGR) electrification to shift long – haul freight from road to rail, reducing congestion and GHG emissions.

iv) Member States to invest in inland waterway transport and intermodal facilities to provide competitive alternatives to road freight.

v) Implement logistics hubs and dry ports to streamline cargo movement, reduce empty truck trips, and optimize load factors on high – emission routes like Mombasa – Nairobi and Malaba/Busia – Kampala.

f) Encouraging Electrification of Freight Transport

i) Conduct a feasibility study to identify strategic locations for electric truck charging stations along the corridor, ensuring accessibility for regional trade routes.

ii) Provide incentives, such as tax benefits, subsidies, or grants, to promote the adoption of electric trucks, supporting Rwanda's and Uganda's electrification strategies.

g) Enhancing Climate – Resilient Infrastructure:

i) DRC and South Sudan to prioritize road infrastructure development and rehabilitation.

ii) Burundi, Kenya, Rwanda and Uganda to prioritize infrastructure rehabilitation.

iii) Northern Corridor member states to establish a baseline on climate resilient infrastructure in Burundi, Kenya, Rwanda and Uganda

iv) Northern Corridor member states to integrate climate adaptation standards into road and rail infrastructure planning to ensure long – term sustainability and resilience against extreme weather,

v) Member States to establish roadside stations for better journey planning to improve efficiency

vi) Member States of DRC, Burundi, Rwanda and South Sudan to install weighbridges, and DRC and South Sudan to adopt and implement the EAC Vehicle Load Control Act 2016 to protect road infrastructure.

h) Continuous Monitoring and Data Collection of GHG Emissions

i) With an established baseline, NCTTCA to conduct annual GHG data collection along Northern Corridor sections to continuously monitor mitigation measures, impacts and track progress toward the Green Freight Strategy 2030's goals, leveraging the Northern Corridor Emissions Index for annual reporting.

These recommendations, grounded in the 2024/2025 baseline, support regional cooperation, align with national NDCs, and drive the corridor toward sustainability, ensuring economic growth and environmental stewardship.

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Annexes

Annex 1: Data Collection Tool for Kenya, Rwanda and Uganda

GHG Accounting

1. Name of the Interviewer:

2. STATION:

- Mariakani Weighbridge
- Athiriver Weighbridge
- Gilgil Weighbridge
- Webuye Weighbridge
- Busia Weighbridge
- Malaba Weighbridge
- Mbale Weighbridge
- Magamaga
- Lukaya
- Mbarara
- Mpondwe Border
- Gatuna Border
- Cyanika Border
- Musanze-Kigali/NR2
- Kigali-Huye/NR1
- Rubavu Border-Musanze/NR2
- Huye- Rusizi/NR10

3. Which module are you taking?

- ◯ VEHICLE ACTIVITY MODULE
- ◯ TALLYING
- ◯ VEHICLE ACTIVITY

» MODULE I A: PRELIMINARY

1. Name of the Interviewee:

2. Name of the Company: (check on the truck or NA)

3. Title / position in the company:

4. Contact No / Phone Number:

5. Number Plate of Vehicle:

6. Country where truck is registered: (check plate No)

- ◯ Kenya
- ◯ Uganda
- ◯ Tanzania
- ◯ DRC
- ◯ Burundi
- ◯ Rwanda
- ◯ South Sudan
- ◯ Other

7. Vehicle Category:

- ◯ LDT/ 2-Axle
- ◯ MCV - 3Axle
- ◯ MCV-4 Axle
- ◯ HCV- 5 & 6 Axle
- ◯ HCV- 7 & 8 Axle
- ◯ HCV- >8 Axle

8. What is the year of manufacture of the vehicle?

9. What is the origin of the journey?

10. What is the destination of the journey?

» MODULE I: B- FUEL CONSUMPTION

11. MODEL:

12. TYPE:

- ◯ Containerized truck
- ◯ Box body truck
- ◯ Skeleton truck
- ◯ Tanker Truck
- ◯ Tipper
- ◯ Other

13. MAX LOAD(TONS)

14. ACTUAL LOAD(TONS)

15. AVERAGE FUEL CONSUMPTION FOR A ROUND TRIP(LITRES)

16. RETURN TRIP EMPTY/LOADED:

- ◯ Empty
- ◯ Loaded

17. FUEL PROVIDED FOR EMPTY RETURN(LITRES):

18. FUEL PROVIDED FOR LOADED RETURN TRIP(LITRES):

20. AVERAGE SPEED:

TALLYING

1. Direction

- ◯ Outbound
- ◯ Inbound

2. Type of vehicle

- ◯ Containerized truck
- ◯ Box body truck
- ◯ Skeleton truck
- ◯ Tanker Truck
- ◯ Tipper
- ◯ Other

Annex 2: Data Collection Tool for Burundi, DRC and South Sudan

GHG Accounting

1. Name of the Interviewer:

2. STATION:

- ◯ KABANGA/KOBERO BORDER
- ◯ BUJUMBURA
- ◯ BUNAGANA/KISORO BORDER
- ◯ MPONDWE BORDER
- ◯ GOLI BORDER
- ◯ NIMULE BORDER
- ◯ JUBA

3. Which module are you taking?

- ◯ VEHICLE ACTIVITY MODULE
- ◯ TALLYING
- ◯ VEHICLE ACTIVITY

» MODULE I A: PRELIMINARY

1. Name of the Interviewee:

2. Name of the Company: (check on the truck or NA)

3. Title / position in the company:

4. Contact No / Phone Number:

5. Number Plate of Vehicle:

6. Country where truck is registered: (check plate No)

- ◯ Kenya
- ◯ Uganda
- ◯ Tanzania
- ◯ DRC
- ◯ Burundi
- ◯ Rwanda
- ◯ South Sudan
- ◯ Other

7. Vehicle Category:

- ◯ LDT/ 2-Axle
- ◯ MCV - 3Axle
- ◯ MCV-4 Axle
- ◯ HCV- 5 & 6 Axle
- ◯ HCV- 7 & 8 Axle
- ◯ HCV- >8 Axle

8. What is the year of manufacture of the vehicle?

9. What is the origin of the journey?

10. What is the destination of the journey?

» MODULE I: B- FUEL CONSUMPTION

11. MODEL:

12. TYPE:

- ◯ Containerized truck
- ◯ Box body truck
- ◯ Skeleton truck
- ◯ Tanker Truck
- ◯ Tipper
- ◯ Other

13. MAX LOAD(TONS)

14. ACTUAL LOAD(TONS)

15. AVERAGE FUEL CONSUMPTION FOR A ROUND TRIP(LITRES)

16. RETURN TRIP EMPTY/LOADED:

- Empty
- Loaded

17. FUEL PROVIDED FOR EMPTY RETURN(LITRES):

18. FUEL PROVIDED FOR LOADED RETURN TRIP(LITRES):

20. AVERAGE SPEED:

TALLYING

1. Direction

- Outbound
- Inbound

2. Type of vehicle

- Containerized truck
- Box body truck
- Skeleton truck
- Tanker Truck
- Tipper
- Other

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