Tools and guidelines to monitor and track progress made in Botswana's NDC – Transport sector

ICAT
Initiative for
Climate Action
Transparency

Initiative for Climate Action Transparency - ICAT

Report on tools and guidelines to monitor and track progress made in implementing and achieving Botswana's NDC – Transport sector

Deliverable # 3

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Abbreviations

APM	Action, Policy Measures
BAU	Business as Usual
BURS	Botswana Unified Revenue Service
BTR	Biennial Transparency report
BR	Botswana railways
BURs	Biennial Update Report
CH_4	Methane
CO_2	Carbon Dioxide
DMS	Department of Meteorological services
DoE	Department of Energy
DRTS	Department of Road Transport and Safety
DTU	Technical University of Denmark
ETF	Enhanced Transparency Framework
GACMO	Greenhouse gas Abatement Costing model
Gg	Gigagram
GHG	Greenhouse Gas
GoB	Government of Botswana
ICAT	Initiative for Climate Action Transparency
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
kt	kilo tonnes
LULUCF	Land Use and land Use Change and Forestry
M&E	Monitoring and Evaluation
MENT	Ministry of Environment, Natural Resources and Tourism
MPGs	Modalities, Procedures and Guidelines
MRV	Measuring Reporting and Verification
Mkm	million kilometres
Mt	million tonnes
NAMAs	Nationally Appropriate Mitigation Actions
N_2O	Nitrous Oxide

NDC	Nationally Determined Contributions
NDP	National Development Plans
NIR	National GHG Inventory Report
QA/QC	Quality Assurance & Quality Control
SAR	Second Assessment Report 9of IPCC)
SB	Statistics Botswana
TNAs	Technical Needs Assessments
TNC	Third National Communication
TOR	Terms of Reference
UDP	UNEP DTU Partnership
UNEP-CCC	United Nations Environment Programme – Copenhagen Climate Centre
UNFCCC	United Nations Framework Convention on Climate Change

Glossary

Accuracy
A relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, so far as can be judged.

Activity
A practice or ensemble of practices that take place on a delineated area over a given period of time.

Activity data
Data on the magnitude of a human activity resulting in emissions or removals taking place during a given period of time. Data on energy use, metal production, land areas, management systems, lime and fertilizer use, and waste arising are examples of activity data.

Carbon dioxide equivalent emission
The amount of carbon dioxide (CO_2) emission that would cause the same integrated radiative forcing or temperature change, over a given time horizon, as an emitted amount of a greenhouse gas (GHG) or a mixture of GHGs. There are a number of ways to compute such equivalent emissions and choose appropriate time horizons. Most typically, the CO_2-equivalent emission is obtained by multiplying the emission of a GHG by its global warming potential (GWP) for a 100-year time horizon.

Transparency
Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information.

Enhanced Transparency Framework (ETF)
ETF is designed to build trust and confidence that all Paris Agreement Parties are contributing their share to the global effort through MRV of Implementation of their Nationally Determined Contributions (NDC) in order to track if the global goal of achieving 1.5 to 2 Degrees Celsius is being achieved.

Introduction

Background

The Initiative for Climate Action Transparency (ICAT) aims to help governments build capacity to measure the effects of their policies and report progress publicly, thus fostering greater transparency, effectiveness, trust, and ambition in climate policies worldwide. Botswana has prioritized the Energy and Transport sectors for its ICAT activities.

This report is on Deliverable 3- of the ICAT- Botswana study "Develop a list of indicators for NDC tracking and monitoring in the Transport sector" focussing on development of tools for tracking implementation of the Botswana Nationally Determined Contribution (NDC) using a Monitoring Reporting and Verification (MRV) system that is complying with the ETF requirements under the Paris Agreement.

Botswana like other UNFCCC Parties have been undertaking MRV through the National Communications (NCs), biennial update reports (BURs), Nationally Appropriate Mitigation Actions (NAMAs) etc. However, with the advent of the Paris Agreement, Parties are also required to report in a transparent manner and provide necessary information for clarity. This is required for domestic as well as international transparent reporting as part of the global stocking to determine if the Parties are moving towards their targets defined in NDCs, as well as report the capacity building, finance and technological transfers received for mitigation.

Since COP 24 new reporting requirements under the Paris Agreement, ETF require Non-Annex I countries, like Botswana, to report through Biennial Transparency Reports (BTR), whose first submission is due by 31st December 2024 at the latest. The BTR's outline is currently being negotiated at the UNFCCC under the Subsidiary Body for Scientific and Technological Advice (SBSTA), but the provisions embodied in the Modalities Procedures Guidelines (MPGs) have defined that the BTR will constitute the following:

- A national Inventory Report (NIR) of anthropogenic emissions by sources and removals by sinks of greenhouse gases.

- Information necessary to track progress made in implementing and achieving NDCs under Article 4 of the Paris Agreement; and

- Information on Mitigation Actions, Policies and Measures (APM) that support the implementation and achievement of its NDC under Article 4 of the Paris Agreement.

Objectives

The overall objective of the ICAT project for Botswana is to support the development and implementation of a functional MRV system focusing in this case on the transport sector (and energy sector) that will be coordinated by MENT to support MRV in accordance with the EFT under Paris Agreement and ensuring synergies between the two priority sectors. The common deliverables for the two sectors are presented in Table 1 below.

Deliverable 1	Situational Analysis on MRV in Botswana and Needs and gap assessment for MRV in the transport sector (synergizing with the energy sector).
Deliverable 2	Strengthening institutional arrangements for MRV in the transport sector.
Deliverable 3	Develop a list of indicators for NDC tracking and monitoring in the Transport sector. Develop capacity for data management and impact assessment to track NDC implementation in the transport sectors based on ICAT methodologies and/or other available tools.
Deliverable 4	Barrier Assessment for MRV/EFT in the transport sector.
Deliverable 5	Develop a roadmap to ensure the achievement and sustainability of ICAT outcomes.

Deliverable 6	Report documenting the final validation workshop and main outcomes of ICAT Botswana.

Specific to this report for Deliverable 3, is the development of appropriate indicators for both domestic and internationally reporting on the progress of Implementation of the Botswana NDC. MPGs[1] narrate transparent tracking of:

- National GHG Inventory

- Progress in Implementation and achieving of NDC

- Impacts and Adaption

- Financial, Technology Development and Transfer and Capacity Building support- both provided/mobilized and Needed and Received

The key components of tracking NDC Implementation are:

- Indicators to monitor related NDC Mitigation measures and supporting policies presented in the NDC,

- providing data requirements and collection methodologies;

- Analytical tools for collating of data and computation of the indicators, and;

- Institutional arrangements for measurement, verification, and reporting

Methods and Approaches

In developing NDC Tracking system, the method adopted was to review the Botswana NDC report to assess the transport sector measures that have been presented. This was augmented by review of NDC tracking of other countries for the sector.

Relevant transport related policies to be monitored were also presented and analysis provided on how they can be tracked for impact on the implementation of the NDC.

The ICAT and MPG reports were also reviewed to be informed of the requirements of the ETF and what to monitor and how to monitor and report.

Operating tools, GACMO in particular were reviewed to show data requirements, sources of data and required computations to arrive at the key indicator of tCO2eq reduction per year.

In finalization of simple tools to measure and report indicators per sector measure, the institutional arrangements for data collection, computation and reporting are indicated. The tools developed are in WORD and the same data can be used in GACMO or independent excel sheets. The transport sector tools developed in this report are for the mitigation measures as there are no adaptation measures affecting the transport sector.

The Botswana NDC only mentions one transport measure that has not been analysed to present GHG reduction potential and hence no set target. The required indicators, data requirements and tool has been developed for this

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[1] Modalities, procedures, and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement

single measure. In order to create additional MRV resources, additional transport measures listed in the Situational Analysis- Deliverable 1[2] and analysed in the GACMO model, have also been presented, as with appropriate data collection, they can be applicable to Botswana.

Modalities, procedures, and guidelines for the transparency framework

The Modalities, Procedures, and Guidelines (MPGs) in this case have been analysed as they relate to measurement verification and reporting on the following:

1. National GHG Inventory
2. Tracking impact of GHG Mitigation Actions, Policies and Measures (APMs)
3. Means of Implementation (Financing, capacity building, technology transfer)

National GHG Inventory Reporting

Under ETF, Parties such as Botswana will be required to report their national anthropogenic emissions of greenhouse gases (GHGs) by sources and removals by sinks either as a stand-alone report or as part of the Biennial Transparency Report (BTR) starting from 31st December 2024.

The development of the National Inventory Report (NIR) will be based on the IPCC 2006 Guidelines and any latter amendments to the Guidelines. A 100-year GWP horizon is to be adopted using GWP potentials in the AR5 agreed by the Parties to the COP[3].

 Each Party will report its national entity or national focal point with the overall responsibility for the national inventory such as the Botswana DMS supported by the GHG Inventory Team. The inventory development process will ensure that sufficient activity data collection, choice and development of methods, emission factors and other parameters are in accordance with the IPCC guidelines. There is also to be an archiving of all information as what is being done by Statistics Botswana, for the reported time series, including all disaggregated emission factors and activity data, all documentation about generating and aggregating data, including QA/QC, review results and planned inventory improvements; and there should be processes for the official consideration and approval of the inventory[4].

Each Party shall report GHGs by IPCC categories on the seven gases (carbon dioxide (CO_2), methane (CH_4), (nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3)); but due to data constraints non Annex I Parties that have less capacity can report on at least three gases (CO_2, CH_4 and N_2O) as well as any of the additional four gases (HFCs, PFCs, SF_6 and NF_3) if included in the Party's NDC under Article 4 of the Paris Agreement. All GHG inventories will be presented as CO_2eq (in units of mass such as tonnes)

This process of determining GHGs will be used to map the trends (basing on the NDC reference year) and changes

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[2] These transport measures are listed in the ICAT Transport Guide and include other measures that can be implemented in Botswana if data are available.

[3] Since the AR6 is already released, GWP stipulated in that report can be adopted.

[4] Decision -/CMA.1 Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement

in the baseline as a result of application of NDC GHG Mitigation measures.

Tracking Impact of GHG Mitigation Actions, Policies, and Measures

Parties are to provide a description of its NDC which progress will be tracked for the mitigation actions, policies, and measures (APMs), regarding the following information.

- Target(s) and description, including target type(s) (e.g., economy-wide absolute emissions reduction, emissions intensity reduction, emissions reductions below a projected baseline, mitigation co-benefits of adaptation actions or economic diversification plans, policies and measures, and other);

- Target year(s) or period(s), and whether they are single-year (e.g., 2030) or multi-year target(s) (e.g. 2025, 2030, 2035, 2040 etc);

- Reference point(s), level(s), baseline(s), base year(s) or starting point(s), and their respective value(s); In the case of Botswana the NDC has started mapping the baseline from 2014/2015 which are the years reported in the National Inventory Report (NIR, 2015).

- Time frame(s) and/or periods for implementation;

- Scope and coverage, including, as relevant, sectors, categories, activities, sources and sinks, pools and gases;

- Intention to use cooperative approaches that involve the use of internationally transferred mitigation outcomes under Article 6 towards NDCs under Article 4 of the Paris Agreement;

- Any updates or clarifications of previously reported information (e.g., recalculation of previously reported inventory data, or greater detail on methodologies or use of cooperative approaches).

For purposes of tracking the implementation of the NDC, Parties will identify the indicator(s) that may be either qualitative or quantitative. Examples of indicators being used are:

- net GHG emissions and removals,

- percentage reduction of GHG intensity,

- relevant qualitative indicators for a specific policy or measure,

- mitigation co-benefits of adaptation actions and/or economic diversification plans or other (e.g., hectares of reforestation,

- percentage of energy use or production,

- carbon neutrality,

- share of non-fossil fuel in primary energy consumption and non-GHG related indicators).

For each selected/identified indicator most recent data will be used in comparison of baseline with GHG mitigation measure scenario, checking if set targets have been met. The computation shall be transparent regarding key parameters, assumptions, definitions, data sources and models (if any) used.

Means Of Implementation

Parties and those that provide support will report information on financial, technology transfer and capacity building for the same reporting year as for APMs in agreed currency with status whether the support is committed or disbursed and climate specific. Information on the type of channel (bilateral, regional, multilateral etc) and source e.g., ODA, OOF etc) and financial instrument (grant, loans & types, equity, guarantee, insurance etc) will be provided. The tracking will indicate sector supported e.g., transport and whether it is for mitigation or adaptation and if that is for capacity building or technology development and transfer, avoiding double counting and separating out country proportion in multi-country projects. Public and private finances should also be separated out where data allow.

Both committed/disbursed, and support needs can also be reported as data allows.

Botswana Nationally Determined Contributions

Analysis of the targets and mitigation APMs in Botswana's NDC

Botswana is committed to reduce its GHG emission by 15% in 2030 relative to the BAU scenario. The baseline scenario for Botswana includes LULUCF, which is projected to constitute a stable net sink during that period. Mitigation APMs thus include those in the LULUCF sector, where increased retention of GHGs is counted towards the achievement of the target.

Based on the above outlined BAU scenario, the -15% equal to a reduction of 3315 Gg CO_2-eq in 2030 for all the sectors including LULUCF.

Botswana NDC reports on data produced in the NIR for the years 2014 and 2015 providing anthropogenic direct Greenhouse Gases comprising CO_2, CH_4 and N_2O, HFCs and the indirect gases of Carbon Monoxide (CO) and Nitrogen Oxides (NO_x) for the following sectors.

- Energy (inclusive of transport)

- Industrial Processes and Product Use (IPPU)

- Agriculture, Forestry and Other Land Use (AFOLU)

- Waste

The Global Warming Potential (GWP) adopted for both the NIR and NDC were however for IPCC Second Assessment Report (SAR)[5]

Specific to the transport sector CO_2, CH_4 and N_2O were the GHGs considered hence when drawing baseline for transport and mitigation APMs, these are the GHGs to consider but applying the IPCC Fifth Assessment Report (AR5) GWP.

The GHGs denominated to kt CO_2eq were determined and the projected baseline for the transport sector as per the NDC Report is a smooth steady growth from 2352kt CO_2eq in 2015 to about 4800 ktCO2eq in 2030 driven by both

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[5] Differences between SAR and AR5 GWP was however computed.

population and GDP growth rates (Figure 1).
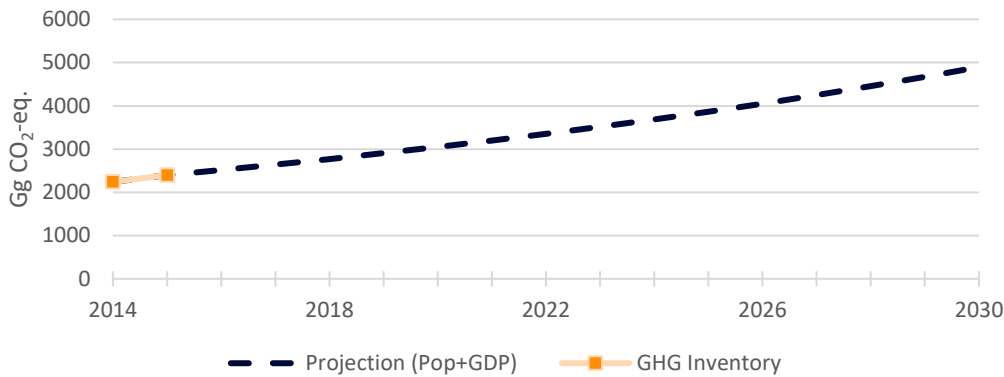
Source: NDC Report Deliverable 8

Figure 1 Transport sector baseline 2014 to 2030[6]

Mitigation measures and targets

The only transport sector measure presented in the Botswana NDC is the regulation of imported pre-owned vehicles and regular monitoring of the old fleet as governed by vehicle emission standards, but the mitigation measure was not quantified (Table 2). The estimated horizon for Measurement, Reporting and Verification for this transport sector measure is tentatively estimated to span the period 2025 to 2030 and due to paucity of data, the measure is not expected to be tracked for period 2020 to 2025.

NDC MEASURE	TARGET 2030 (Gg CO2-eq/year)	RESPONSIBLE DEPARTMENT	CO-BENEFITS	Timeline	
				2020-2025	2025-2030
Regulate the importation of pre-owned vehicles and regular monitoring of old fleet: To ensure that imported vehicles and old fleet fall within the desired vehicle emissions standards	Not yet quantified	Ministry of Transport (DRTS)	Improvement of air quality		⬚

Source: NDC Report Deliverable 8

Table 1 Transport sector NDC Mitigation Action in the Botswana NDC

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[6] Deliverable 8 under the Project: "Consultancy to review and revise the current Botswana Nationally Determined Contributions (NDC) *May 2022 version*" GHG_NDC_MRV_Energy Excel data sheets.

In the practice of tracking APMs in the NDC, the set target in the NDC would be tracked. The tracking of this transport measure is thus limited by the fact that no GHG reduction potential was estimated in the NDC and there are no targets set for it. The data required can be sourced on imported vehicles and monitoring the vehicle vintages annually, both data sets can be obtained from DRTS and BURS statistics hence some GHG reduction potential can be estimated basing on fuel economies of old and newer vehicles.

Apart from this only NDC Transport mitigation APM, the other measures that have been proposed in the 2016 NAMA, TNC 2019 and Integrated Transport Policy are presented in Table 3. These can also be considered for tracking as they are already recognized in the national policy instruments.

Policy Instrument	GHG Mitigation Measure	Anticipated impacts
NAMA, 2016	• Introduce tax on petroleum products • Introduce parking fees and control parking on empty spaces	Increase in the cost of using private vehicles Discourage individuals to use large engine vehicles.
		Increase the cost of using vehicles Increase the number of people using public transport
Third National Communication-2019	• Improved Public Transport	Reduced energy intensity per passenger
Integrated Transport Policy 2011	• Improving the public transport systems which will encourage the public to use public transport systems. • Reducing high import bill from petroleum imports • Reducing traffic congestion in the capital city.	Reduced energy intensity per passenger Improved vehicle economy

Table 2 Transport GHG Mitigation Options proposed in the NAMA (2016)

The other transport measures that can be considered for tracking that Botswana can deploy in its endeavour to reduce vehicular pollution, congestion and GHG reduction are in the ICAT Transport Guide and also other listed in Deliverable 1 of the ICAT Study for Botswana that are commonly deployed in similar countries (Annex 6.1).

Considering the GHG abatement options in the model GACMO (Refer to Annex 6.2) developed by UNEP-CCC

(formerly DTU), the majority of these additional APMs for Transport can be tracked using GACMO provided the required data are available as indicated in Annex 6.4.

Tracking tools for transport sector mitigation measures

In order to track performance of NDC Implementation and target towards the -15% of baseline by 2030, some indicators are needed for the deployed transport mitigation measures as indicated below in the following section.

Proposed Macro and Energy-related indicators for mitigation activities and targets

Table 4 shows the commonly stipulated indicators for the transport measures[7]

Group	Indicator	Description	Remarks
Macro	Total GHG emissions trend	Total annual CO2-eq emissions (kt)	This is a relevant indicator to evaluate the impact of policies and measures on GHG emissions over time. It is particularly relevant for NDC targets expressed in the form of absolute-base year targets and peaking targets. It is also needed for tracking BAU targets.
Macro	Total carbon intensity of the economy	Total annual CO2-eq emissions (kt) per GDP (bn Currency)	Total CO2-eq emissions (excluding LULUCF) and gross domestic product at constant prices are considered. This indicator is particularly relevant for NDC intensity targets.
Macro	Per-capita carbon intensity of the economy	Total annual CO2-eq emissions (kt) per inhabitants	Total annual GHG emissions (with or without LULUCF) and the number of inhabitants is considered. This indicator is particularly relevant for NDC intensity targets.
Energy - Transport	Specific GHG emissions from transport sector	Annual CO2-eq emissions from transport sector (kt) per final energy consumption (TJ)	This indicator takes into account annual GHG emissions deriving from transport sector (considered as a whole or differentiated by subsector: domestic aviation, road transportation, railways, domestic navigation, other transportation) and respective final energy consumption (from all energy sources, including biomass and electricity consumption), allowing tracking changes of transport performances about greenhouse gas emissions per final energy consumption over the years.
Energy - Transport	Specific GHG emissions of passenger cars with respect to mileage travelled	Annual CO2-eq emissions from road passenger cars (kt) per mileage travelled (Mkm)	This indicator considers annual GHG emissions deriving from passenger cars category, considered as a whole or differentiated by fuel, and the respective number of vehicle kilometres travelled (source: transport statistics), considering that activity data should be consistent with the emission data, allowing tracking changes of the performances of the passenger cars in relation to greenhouse gas emissions per vehicle-km over the years.
Energy -	Specific road transport	Annual fuel	This indicator takes into account annual consumptions

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[7] ISPRA, Rapporti 340/21 ISBN 978-88-448-1045-0. Proposed Indicators for Domestic MRV Purposes and tracking Progress of NDCs, April 2021

Transport	fuel consumptions	consumptions of road transport vehicles (MJ) per distance travelled (km)	(MJ) of the different road transport vehicle categories (passenger cars, light duty trucks, heavy duty trucks, buses, two-wheeled vehicles) and the respective distance travelled (source: transport statistics), allowing tracking changes of the efficiency of the vehicles over the years.
Energy - Transport	Road transport vehicle fleet complying with highest emission standards	Share of vehicles complying with highest emission standards compared to the total road transport circulating fleet %	This indicator takes into account the number of vehicles complying with highest emission standards (according to the vehicle fleet classification adopted in the Country), distinctly for road transport vehicle category (passenger cars, light duty trucks, heavy duty trucks, buses, two-wheeled vehicles), and the respective total number of circulating vehicles (source: transport statistics), allowing tracking changes of the penetration of more modern vehicles in national road transport fleets.
Energy - Transport	Use of alternative fuels in transport	Share of alternative fuels consumption compared to the total energy consumption in transport sector (%)	This indicator considers the amount of alternative fuels consumption (including natural gas, LPG, biomass and electricity consumption) and the total final energy consumption (from all energy sources) in transport sector (including domestic aviation, road transportation, railways, domestic navigation, other transportation) allowing tracking changes of the penetration of fuels with a lower environmental impact.
Energy - Transport	Electrification of the railway network	Share of the electrified railway network compared the total network (%)	This indicator considers the length data (km) of the total railway network and of the electrified portion (transport statistics) allowing to represent the electrified share of the railway infrastructure of a territory.

Table 3 Common indicators for transport GHG Mitigation measures and at Macro level

Such suite of transport indicators can also guide tracking impact of APMs in the transport sector, where applicable. Specific indicators adopted for the selected transport measures are provided in section 4.2.

Tracking tool for the NDC transport sector measure

The tracking, data requirements and manipulation for the one NDC Transport Measure "*Regulate the importation of pre-owned vehicles and regular monitoring of old fleet- To ensure that imported vehicles and old fleet fall within the desired vehicle emissions standards*" is presented below (Table 5). Critical to the tracking is the definition of the indicator and related target capacity and target GHG emission reduction if known.

Administration information is also important in terms of frequency and timing of the Measurement, Reporting and Verification and the critical organizations in Botswana that can provide the needed data and undertake the computation of the indicator and related targets. It is also important to quote if there is a supporting existing or needed policy instrument for the GHG Mitigation measure to be implemented. The comparison between Baseline/Reference scenario and Mitigation measure scenario has been adapted from GACMO and examples of numbers are provided from that model. The general emission factors for petroleum products used in the transport sector and GWP adopted are presented in the Annex 6.3.

Title: Regulate the importation of pre-owned vehicles and regular monitoring of old fleet- To ensure that

imported vehicles and old fleet fall within the desired vehicle emissions standard.			
Year of computation (annually)			e.g. 2022
Responsible stakeholder organization			DRTS supported by BURS
Focal person in the department			To be nominated
Relevant policy supporting implementation of APM	Integrated Transport Policy		Status: existing
TRACKING- targets	Non yet determined		
	Description	Unit	Sources of information/analysis required
Indicator	GHG Reduction by measure from transport BAU in 2030 (see figure 1)	$ktCO_2$ eq	DRTS
Target capacity by 2030 (Specify age limit of vehicles)	Used imported vehicles and old vehicles in the country fleet	%	Not specified in NDC- but can be computed
Target emission reduction by 2030	Proportion of transport GHG emissions (towards -15% for whole economy)	%	Not specified in NDC and not computed But can be computed
Reduction option: import of gasoline cars with higher fuel efficiency			
Activity- no of high fuel efficiency cars imported annually-example only	1 000	Cars	BURS
Energy consumption of newer vehicle	15	km/l	benchmark
Annual distance per vehicle	12 000	km	DRTS/estimated
Total gasoline consumption	0,80	Million liters	computed
Total gasoline reduction	0,3	ktoe	computed
Emission	1 863	tCO_2eq	computed
Reference/baseline option: Import of used gasoline cars with low fuel efficiency (similar number of cars are assumed in the baseline scenario)			
Energy consumption of old vehicles	10,0	km/l	benchmark

Total gasoline consumption	1,20	Million liters	computed
Emission	2 794	tCO$_2$eq	computed
Emission reduction			
	931	tCO$_2$eq	computed

Source: figures are from GACMO as example

CO2 emission reduction		tCO$_2$	GWP 1 -
CH4		Kt	GWP 28 -
N2O		Kt	GWP 265 -
total GHG emission reduction	931	tCO$_2$eq	-
GHG emission reduction to target [8]	0.28	%	Compared to economy wide GHG reduction of 3315 k tCO$_2$eq -

Green- main input

Table 4 Tracking the NDC Transport Measure and data requirements

In the instance where GHGs are required separately and not as ktCO$_2$eq, reporting can first be presented above. If there is a specific target for the transport measure by 2025 and 2030, then the remission reduction can be computed as a % of the target showing the contribution of the transport measure to the overall target. In this case the single transport measure in the NDC does not have a target of its own hence the contribution of the measure can also be based on the economy wide target of 15% by 2030 or a GHG reduction in the transport sector of 4800 ktCO$_2$eq.

Tracking other transport sector measures

Another measure is presented below that can be applied to Botswana by shifting freight from road to rail for some commodities. This transport measure is analysed in GACMO.

Shifting freight transport from road to rail

Year of computation (annually)			e.g. 2022
Responsible stakeholder organization			**Botswana Railways**
Focal person in the department			**To be nominated and trained**
Policy to support transition			
TRACKING- targets	**None yet determined**		
Indicator	GHG Reduction by measure towards - 15% national target?	%	BR

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[8] In this case only if 1000 imported vehicles are avoided

Target capacity by 2030	Freight (to-km) carried by road and Rail compared to baseline	%	Not specified in NDC- but can be computed
Target emission reduction by 2030	% of baseline transport GHG emissions (towards -15% for whole economy)	tCO2 eq	Not specified in NDC and not computed But can be computed

Reduction option: Road to rail Freight			
Activity- no of avoided freight load	365000	Tonne-km per year	BR
Specific diesel consumption	0,00470	l/ton-km	benchmark
Total diesel consumption	1717	litres/year	computed
Total gasoline reduction	0,3	ktoe	computed
Total Diesel Emission	5	tCO2eq	Computed using AR5 GWP
Reference/baseline option: Road Freight			
Number of trucks to carry t-km under activity	167	Trucks per day	
Truck distance	6	km/day	estimated
Diesel consumption	4,0	km/l	benchmark
Total diesel consumption	91 250	litres/year	computed
1000 l diesel	39,0	GJ	computed
CO2-eq. emission coefficient	74,1	kgCO2-eq./GJ	See general factors
Emissions from diesel	263,6	tCO2eq/year	Computed using AR5 GWP
Emission reduction			
	258.6	tCO2eq	computed

Green- main input

Electric rail

Year of computation (annually)		e.g. 2022	
Responsible stakeholder organization		**Botswana Railways**	
Focal person in the department		**To be nominated and trained**	
Policy to support transition			
TRACKING- targets	**None yet determined**		
Indicator	GHG Reduction by measure towards -15% national target?	%	BR
Target capacity by 2030	Train km on electric as proportion of baseline diesel train-km/year	%	Not specified in NDC- but can be computed

Target emission reduction by 2030	% of baseline transport GHG emissions (towards -15% for whole economy)	tCO2 eq	Not specified in NDC and not computed But can be computed

Reduction option: New electric trains			
Annual activity	1.7 million trainkm/year		Main input
Specific consumption	6,55	kWh/trainkm	benchmark
Electricity consumption	11	GWh/year	computed
CO2-eq. emission coefficient	0,49	tCO2/MWh	
Emissions	5 406	tCO2eq/year	GWP applied
Reference option: Normal diesel rail			
Specific diesel consumption	1,41	liter/trainkm	benchmark
Diesel consumption	2,40	Million liter/year	computed
1000 l diesel=	39,0	GJ	General factor
Diesel consumption	93 476	GJ/year	computed
CO2-eq. emission coefficient	74,1	kgCO2-eq./GJ	Emission factor for diesel (Annex 6.2)
Emissions	6 923	tCO2eq/year	GWP applied

Electric vehicles

Year of computation (annually)		e.g., 2022	
Responsible stakeholder organization		**Department of Energy assisted by DRTS**	
Focal person in the department		**To be nominated and trained**	
Policy to support transition			
TRACKING- targets	**None yet determined**		
Indicator	GHG Reduction by measure towards -15% national target?	%	DoE
Target capacity by 2030	Electric cars on the market in the year compared to total cars in the country by vehicle type if applicable	%	Not specified in NDC- but can be computed
Target emission reduction by 2030	% Of baseline transport GHG emissions (towards -15% for whole economy)	tCO2 eq	Not specified in NDC and not computed but can be computed

Annual distance	12 000	km	Main input
Activity	1 000	Cars	Main input
Reduction option: Electric cars			
Size of battery	40	kWh	benchmark
Electricity consumption	7,7	km/kWh	benchmark

Total electricity consumption		1 560	MWh	computed
CO2-eq. emission coefficient	0,49		tCO2/MWh	General factor
Emissions from electricity		757	tCO2	
Economic efficiency		0,31	US$/km	
Reference option: Normal gasoline cars				
Energy consumption		16,8	km/l	benchmark
Total gasoline consumption		0,71	Million liters	computed
1000 l gasoline =		33,6	GJ	General factor
CO2-eq. emission coefficient	69,3		kgCO2-eq./GJ	Emission factor
Emissions from gasoline		1 663	tCO2	computed
Emission reduction				
GHG reduction potential	906		tCO2eq	GWP applied

Green figures- main inputs

Similar transport measures can be computed in GACMO and key stakeholders can be trained in the use of the model. Annex 6.3 presents general important factors needed to translate fuel volumes (litres) into weight (toe) or TJ for computation with GHG emission factors of each fuel type in both the baseline and GHG reduction scenarios.

The other transport measures that can be analysed in GACMO are indicated in Annex 6.1.

General data requirements for the majority of the transport measures in the ICAT Guide and other measures are listed in Annex 6.4.

Tracking tools for finance, technology transfers, and capacity building

Tracking financing for NDC implementation

Paris Agreement Articles 9, 10, and 11 states that the developing countries shall provide information on financial, technology transfer and capacity-building support needed and received (UNFCCC, 2020). The tracking tools for the financial resources and technological transfers have been prepared based on the MPG.

Tracking tools presented for financial, technology transfer and capacity-building support have been adapted from the energy sector tools to avoid duplication of efforts.

Table 6 depicts the tracking tools for financial support received for the implementation of NDCs. As there are different departments that may receive financial support for the energy mitigation, it is advisable that this tracking tool should be used by all the department implementing the energy mitigation. The financial resources received by the different line ministries and their respective departments should be totalled each year for easy of reporting.

Date						
Recipient/implementing entity						
Name of the person						
Source of funding	(options=government, climate financing, donor funding, Development Financing partner)					
	US$			BWP		
Amount						
Year of funding received						
Expected time frame of funding	(if annual breakdown of budgets given, indicate portion of budget for year of tracking)					
financial instrument	grant	concessional	non-	equit	guarant	insuran

		loan	concessional loan	y	ee	ce
		Committed			Received	
status		(Options, requested, planned, committed, received)				
		Technological transfers	Capacity building		mitigation measure	
Type of mitigation activity funded						
Name of Transport Measure						
		Planned	On-going		Completed	
Status of the Implementation of the measure						

Table 5 Tracking Annual Financing towards NDC implementation for the transport sector.

Tracking tools for technology transfers for transport sector

Technological transfer is one of the imperatives of global emissions reduction. Article 10 paragraph 4 is specifically focused on technology transfer framework. The purposed technological transfers framework is to provide overall guidance on promoting and facilitating enhanced action on technology development and transfer in order to support the implementation of the Paris Agreement[9] Emphasis of the Paris Agreement Technological transfer framework is on the following key areas:

- Innovation

- Implementation

- Enabling environment and capacity building

- Collaboration and stakeholder engagement

- Support

In line with the MPGs, it is essential that that technological transfer is tracked and reported as per the EFT. Similarly, the Technological transfer Framework emphasis the need to developing a system for monitoring and tracking of actions and activities undertaken, and support received, by the Technology Mechanism to implement the technology framework[10].Thus, based on the MPG guidelines, Table 7 depicts the tracking tools for tracking technological transfers. Similarly, to financial support received, it is critical that the tracking tool is used by all the relevant recipients on annually basis to ensure that all the technological received is captured.

Date	
Name of ministry	
Recipient/implementing entity	

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[9] UNFCCC (2017) Technology framework under Article 10, paragraph 4, of the Paris Agreement. https://unfccc.int/sites/default/files/resource/cp24_auv_cop_4_TF.pdf

[10] ibid

Name of the person	
Type of technology received	(hardware/equipment/product, knowhow/software, organo/system)
Source of support	(donor, DP, climate finance etc)
Transport measure supported	
Time frame	

Status of activity	planned	on-going	completed

Table 6 Tracking technology transfer for the transport sector.

Capacity building tracking tool for transport sector

Capacity building is another key aspect that will provide an enabling environment for the implementation of NDC mitigation activities. mitigation measures such as retrofitting, concentrated solar power and solar appliances will require capacity building of various stakeholders. similarly, as per the MPG, this capacity building initiatives need to be tracked and reported in accordance with the EFT.

Table 8 depicts the tracking tools for the capacity building undertaken to enable implementation of the NDC.

Name of recipient entity					
Name of implementing entity					
	Short course	Long term course	On-line	On job training	Other (Specify)
Type of capacity development					
Status of NDC Implementation for transport measure	planned	ongoing	completed		
Number of participants in capacity Building					
List of stakeholders trained					
Value of Training US$					

Table 7 Tracking Capacity Building for NDC Implementation in the transport sector.

Tracking tools for policies and measures

Policies and legal framework are an important component on the NDC. Policy creates an enabling environment to enhance and facilitate implementation of the NDC. Similarly, as noted in the Technological transfer frameworks, policy is paramount to the technological transfers and innovation. Policy efforts and their impacts in terms of GHG emission reduction are also to be reported as per the MPGs. Table 9 depicts the tracking tools for the policy and measure that the GoB will implement to achieve its NDC target.

Date	
Implementing entity	
Name of person	

Name policy			
Type of instrument	Legal	financial	regulatory
Status	Planned	Under development	Existing/undue implementation
Year of instrument			
Description of the policy targets for sector			
Objective of policy/measure			
Target mitigation area in the sector			

Table 8 Tracking formulation and implementation of policy instruments regarding NDC Implementation

Conclusions and recommendations

The NDC tracking tools have been based on the Modalities, Procedures and Guidelines under the ETF of the Paris Agreement with regard to computation of GHG emissions using the IPCC 2006 Guidelines and the latest GWP.

The Botswana NDC has mentioned only one transport measure that has no targets and the GHG reduction potential has not been determined. The expectation is that the transport measure will be reported from 2025 to 2030. In this exercise, a tool has been developed for this transport measure to compute GHG reduction on an annualy basis using vehicle import statistics and vintage of existing vehicles.

The opportunity exists to compute GHG reduction potential of other transport measures that are applicable to Botswana although not in the NDC. Both the ICAT Transport Guide and GACMO provide facilities for determing the GHG reduction potential of the other transport measures.

Additional transport measures that include shift from road freight to rail freight, electric rail compared to diesel fuelled trains and introduction of electric cars have been presented basing on GACMO as additional resource.

The tools developed here only show GHG reduction potential and not abatement costs as the GACMO is intended to determine.

The following recommendations are presented regarding the transport sector NDC tracking.

1. The GHG reduction measures should target specific stakeholder e.g., all road transport measures should be done by DRTS; all railway transport measures by Botswana railways.

2. Application of existing transport statistics should be undertaken to map gaps in data collection.

3. All annual data sets and computations should be captured to present historical series and comparisons over the years. This can be done by the Statistics Botswana

4. Statistics Botswana should also train the targeted stakeholders on quality assurance and then provide QC for the data sets used in the NDC tracking.

5. The collation of the GHG reduction impacts of the transport measures will be made by the Transport Sectoral Working Group as proposed in Deliverable 2. Final compilation of NDC tracking will be undertaken by the Technical Management Unit for purpose of both domestic and international reporting.

6. GACMO is also designed to collate contributions of all GHG abatement measures included hence total contribution of all transport measures that can be implemented in Botswana can be presented together and so showing total transport GHG reduction as a proportion of economy wide GHG reduction potential of 15%.

7. Training of the nominated contact person in each targeted transport stakeholder organization will require training on the collection, manipulation of appropriate data and also on using GACMO model. UNEP-CCC will be mobilized to assist with training on the GACMO model.

8. The DMS/TMU that is in charge of national wide NDC preparation and Reporting can be tasked with the M&E the NDC implementation and target achievement.

Annexes

Annex 1: Transport measures in ICAT guide and derived from Botswana instruments

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Source ICAT Transport Guide

- *Fuel subsidy removal: Removal of subsidies that reduce the price of vehicle fuel below its fair- market cost.*
- *Increased fuel tax or levy: An increase in the tax imposed on each unit of vehicle fuel, which may include general taxes that apply to many goods and special taxes specific to vehicle fuel.*
- *Road pricing (road tolls and congestion pricing): Motorists pay directly for driving on a particular roadway in a particular area. Road pricing has two general objectives; revenue generation and congestion management.*
- *Vehicle purchase incentives for more efficient vehicles: Governments increase the fuel efficiency of the vehicle fleet and/or promote a shift to lower-carbon fuels by providing incentives for the purchase of selected vehicles.*

Table 1.   *This policy is most applicable to electric, plug-in hybrid- electric, hydrogen-fuelled and other vehicles that are not powered by gasoline or diesel, and is applied by governments through lower purchase taxes, purchase rebates, income tax credits and lower vehicle taxes (GACMO=1,2,5,6,7,8,9,13).*

Other transport actions that may be of interest to Botswana are *:*

- *Vehicle import duty to guide what vehicles may be imported and limit no of imported old vehicles (GACMO=14)*
- *Non-Motorised Transport in urban areas to limit use of fuelled vehicles and hence pollution and congestion (GACMO=17)*
- *Traffic regulation measures including technological applications for smooth flow of traffic.*
- *Public transport substitution (GACMO=11)*
- *Vehicle emissions control*
- *Urban planning*
- *Fuel efficiency standard of internal engines (GACMO=3, 4)*
- *Road freight to Rail freight (GACMO=12)*
-

SOURCE: SITUATIONAL ANALYSIS REPORT- DELIVERABLE 1

Annex 2: Transport measures in GACMO

Transport options
1. Biodiesel blended in all remaining diesel
2. Bioethanol blended in all gasoline
3. More efficient gasoline cars (1000 cars)
4. More efficient diesel cars (1000 cars)
5. Electric cars
6. Electric 18m buses

Annex 3: General factors – Energy and emission factors

Source:

http://www.iisd.org/gsi/sites/default/files/bf_uk_fqdmodel.pdf

CONVERSION FACTORS			
	Tonnes	Litres	
Ethanol	1	1 324	
Biodiesel	1	1 132	
Diesel	1	1 190	
Gasoline	1	1 333	
	Tonnes	TOE	GJ
Ethanol	1	0,64	26,8
Biodiesel	1	0,86	36,0
Diesel	1	1,03	43,3
Gasoline	1	1,07	44,8

Emission factors- Kg/GJ	CO_2	CH_4	N_2O	ton CO2e/GJ
Fuel oil	77,4	0,003	0,0006	0,0768
Diesel oil	74,1	0,003	0,0006	0,0736
Gasoline	69,3	0,003	0,0006	0,0688
Jet fuel	71,5	0,003	0,0006	0,0710
GWP (AR5)	1	28	265	

Annex 4: ICAT transport measures and data requirements

The current transport guide makes analysis of the following transport actions that may be introduced or are already introduced and data requirements.

	ICAT Transport Measure	Activity data	Emission factors	Data Collected	Other data sources	Data to be collected	
•	Fuel subsidy removal: Removal of subsidies that reduce the price of vehicle fuel below its fair-market cost.	Fuel economy old versus new. Litres of fuel consumed by vehicles annually, gasoline/diesel Km/ travelled/ vehicles annually. Number of first registration of electric trains replacing diesel trains. Number of electric, cars, buses and trucks first registration. Bicycle users. Number of fuel vehicle first registration. Current fuel price for gasoline and diesel vs the old fuel price. Number of vehicles by engine size.	Gasoline and diesel factors-kg CO_2e/GJ.	Annual vehicle stock. Annual figures for first for first time registration of privately owned vehicles. Annual number of privately owned vehicles. Air transport traffic figures, annually. Yearly, rail road traffic figures.		Kms travelled/ yearly/ vehicles. Litres of gasoline and diesel consumed yearly. Gasoline Price. Diesel price.	
•	Increased fuel tax or levy: An increase in the tax imposed on each unit of vehicle fuel, which may include general taxes that apply to many goods and special taxes specific to vehicle fuel.	Fuel consumed per year I e.g. from national energy balance Disaggregation of cars by type and year of registration, road, rail; passenger (car versus Bus), freight Shares of gasoline and diesel Average distance travelled by each vehicle type- passenger, freight, rail Occupancy of passenger cars/buses; tonnage of freight vehicles	CO_2e/p-km car.	Air transport-International and local traffic figures. Annual railroad traffic figures by direction. Annual vehicle stock.		Fuel tax/ levy rate. Litres of Gasoline consumed yearly. Litres of Diesel consumed yearly. Km travelled yearly/ vehicle.	

• Road pricing (road tolls and congestion pricing): Motorists pay directly for driving on a particular roadway in a particular area. Road pricing has two general objectives; revenue generation and congestion management.	Yearly amount of money raised from road pricing. Fuel consumption for gasoline and diesel. Number of road traffic collisions annually. Kms travelled/ yearly/vehicle. Vehicle density on priced roads. Number of private car versus public transport trips on priced roads. Number of bicycle users using priced roads. Annual number of passengers ferried in trains.	CO_2e/p-km for car. CO_2e/p-km for bus. CO_2e/vehicle km.	Total road Accidents. Annual number of privately owned vehicles. Annual figure of railway traffic by direction. Number of transport accident casualities.		Litres of gasoline consumed yearly. Litres of diesel consumed yearly. Amount of money raised from road pricing per year. Annual figure of road traffic by direction.	
• Vehicle purchase incentives for more efficient vehicles: Governments increase the fuel efficiency of the vehicle fleet and/or promote	✓ No of vehicles by engine size (LDV, passenger, truck, buses etc) ✓ Prices of old and new vehicles ✓ Km travelled/year/vehicle ✓ Market share/penetration rate/year ✓ Fuel prices gasoline/diesel versus e.g. electricity/hydrogen/biofuels. OR vehicle efficiency of old versus new ✓ Incentive/tax value	CO_2e/vehicle km	Annual vehicle stock figures. Data on first time registered-privately owned vehicles, annualy.			

a shift to lower-carbon fuels by providing incentives for the purchase of selected vehicles. *Table 2.* This policy is most applicable to electric, plug-in hybrid- electric, hydrogen-fuelled and other vehicles that are not powered by gasoline or diesel, and is applied by governments through lower purchase taxes, purchase rebates, income tax credits and lower vehicle taxes.					
Other transport actions that may be of interest to Botswana are :					
• Vehicle import duty to guide	1. No of vehicles imported/year by size 2. Duty/tax/incentives $/l size old versus	Gasoline emission factor kgCO2e/GJ	Annual vehicle stock figures. Annual figures of		

what vehicles may be imported and limit no of imported old vehicles	new 3. Gasoline price 4. State subsidy/tax 5. Fuel economy old versus new per car 6. Annual distance travelled by car		of privately owned vehicles registered for the first time.		
• Non Motorised Transport in urban areas to limit use of fuelled vehicles and hence pollution and congestion	(a) No of vehicles used per year by size in boundary area (b) Fuel economy of average vehicles (c) No km travelled per vehicle/per year in urban area/occupancy (d) No of km travelled on non motorised per year (e) Bicycle network km (f) Bicycle users	CO2/vehicle Km.	Annual figures of rail road traffic by direction.		
• Traffic regulation measures including technological applications for smooth flow of traffic.	Kms/ vehicles/ yearly. Fuel consumed by vehicles yearly, diesel or gasoline. Number of vehicles charged with emissions related offenses. Number of car crushes in urban areas.	CO2e/p-km for car. CO2e/p-km for bus. CO2e/vehicle km. Diesel and gasoline emission factors-kgCO2e/GJ.	Annual number of road accidents. Annual figure of road accident casualties.		
• Public transport substitution	**Car versus bus** No of passenger cars used in boundary area No of passengers per car	CO2e/p-km for car CO2e/p-km for bus Diesel and gasoline emission factors-			

		Gasoline consumption per car No of buses to substitute cars/no of passengers per bus Annual distance travelled-pkm Diesel consumption per year or l/p-km	kgCO2e/GJ				
•	Vehicle emissions control	Number of vehicles by engine (buses, cars, LDV, trucks, passenger etc). Vehicle Number of old vs new vehicles. Litres of fuel consumed per year, gasoline/ diesel. Fuel economy	CO2e/p-km for car. CO2e/p-km for bus. Diesel and gasoline emission factors-kg CO2e/GJ				
•	Urban planning	Litres of fuel consumed per annum in urban areas. Traffic volume in CBDs. Bicycle network kms in urban areas. Kms travelled by non-motorised vehicles in urban areas per year. Kms/travelled/vehicles per year in urban areas.	CO2e/vehicle km.				