Report on the stock-taking exercise & ensuring cohesion between Phase I and II ICAT Botswana

Initiative for Climate Action Transparency - ICAT

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Deliverable 1

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Acronyms

AB	Air Botswana
BPC	Botswana Power Corporation
BR	Botswana Railways
CAAB	Civil Aviation Authority of Botswana
DMS	Department of Meteorological Services
DoE	Department of Energy
DRTS	Department of Road Transport and Roads Safety
GACMO	Greenhouse Gas Abatement Cost Model
GHGs	Greenhouse Gases
GoB	Government of Botswana
ETF	Enhance Transparency Framework
ICAT	Initiative for Climate Action Transparency
IPPU	Industrial Process and Product Use
NDC	Nationally Determined Contributions
MRV	Measuring, reporting and verification
NSS	National Statistical System
QA/QC	Quality Assurance and Quality Control
SB	Statistics Botswana
UNEP	United Nations Environment Programme
UNEP-CCC	UNEP Copenhagen Climate Center

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1.0. Introduction

The Initiative for Climate Action Transparency (ICAT) was established in 2017. It was founded to support developing countries (UNFCCC Party Members) in strengthening their institutional capacities to build robust transparency frameworks that enable them to effectively achieve the Paris Agreement and its Enhanced Transparency Framework targets. By providing tailored support and practical tools and proven methodologies, ICAT aims at empowering governments to develop the transparency frameworks necessary for effective climate policies that harmonize with their national development priorities (UNEP, 2024). Since its inception, the initiative has worked with over 40 countries globally in strengthening their monitoring and reporting framework to measure and report their Nationally Determined Contribution (NDCs) in a transparent manner.

Botswana joined ICAT programme in the late 2020. Pursuit to the ICAT objective of enhancing the member states capacity to measure and report their Greenhouse gas (GHG) emissions in a transparent manner, the Government of Botswana (GoB) in Partnerships with United Nations Environment Programme (UNEP) Sweden initiated ICAT Phase I in 2021. ICAT Phase I focused exclusively on the energy and transport sectors to strengthen the country's institutional capacities to meet the ETF requirements. Key deliverables of ICAT Phase I were: undertaking situational analysis on the Measuring, reporting and verification (MRV) and climate data analysis; Barriers assessment and recommendations to the MRV/EFT; development of the NDC tracking tools; identification of synergies and linkages to leverage mitigation to existing government initiatives in accordance with the Paris Agreement and its transparency framework; and tools and guidelines to monitor and track progress made in Botswana's NDCs.

As a continuous process, the GoB in partnerships with UNEP Copenhagen Climate Center is commencing ICAT Phase II to further strengthen Botswana 's MRV institutional capacity. The overall objective of ICAT Botswana Phase II project is to further support the government to plan, measure, manage and

track the implementation of its NDC mitigation actions and expected GHG impacts, by continuing capacity building and strengthening frameworks for emissions projections of selected interventions, impact assessment and a regular data collection, tracking and management framework for the NDC. This will include those needed to project GHG emissions/removals, assess the impact of relevant policies and measures, and develop appropriate indicators for reporting on progress achieved.

In order to optimise the outputs of Phase II and create robust synergies, it is necessary to undertake a stocking exercise to assess whether the outputs of Phase I have been implemented and identify areas for leveraging Phase I and II. This approach will ensure that there is continued and systematic institutional capacity strengthening.

2.0. Objective of the report

The main objective of this exercise is to undertake a stocktaking exercise, based on available resources and results from ICAT Botswana Phase I project, with the specific objectives of assessing:

- The current status of data collection, data sources, processing, data management, institutional arrangements in place, and key priorities for the MRV system, projections, and NDC tracking in the Energy and Transport sectors.
- The existing capacity across sectors and key gaps/needs related to the NDC development, identified indicators, projections and other technical work that has been done.
- Knowledge and capacity in the country, training needs, and who should be trained.
- Opportunities to align the NDC tracking activities with the updates to the GHG inventory including needs and gaps for effective compilation of the national inventory reports for the Energy and Transport sectors.

3.0. Methods and approaches

The stock-taking exercise serves as the inception stage for Phase II, aiming to map the current MRV landscape and identify progress from Phase I. Achieving the main objective and specific objectives involved two primary methods being desk review and key stakeholder consultation.

Desk review involved identifying and reviewing all the relevant documents on data systems (collection, storage and sharing protocols), data sources, and institutional arrangements in place, NDC indicators, and the institutional capacity. Hence, deliverables from Phase I were collated and reviewed to assess the extent to which the recommendations were implemented. Furthermore, existing documents on institutional capacities and knowledge on ETF, MRV and NDC tracking were reviewed to assess the level of expertise and knowledge existing within the country. Hence all relevant documents that contributed to achieving this objective were collected and reviewed. Emphasis was placed on data system (collection, sources and institutional arrangements), improving knowledge and expertise on NDC tracking and establishing ETF, GACMO expertise and knowledge amongst others.

The second method that was employed was stakeholders' consultation. This is an important method as it gives first-hand information on what has been implemented based on the Phase I recommendations. A guiding questionnaire was developed which guided the consultation process. The main institutions which were consulted took part in GACMO (Greenhouse Gas Abatement Cost Model) training offered during Phase I and they included: National GHG Inventory Team which represented various governmental departments and universities. Further consultation was done with the National GHG Inventory team to identify the self-identify skill gaps.

3.1. Expected outputs

The expected outcome from the report is a detailed inventory of the GoB data system on NDC initiatives covering the energy and transport sectors and availability to apply GACMO and other ICAT methodologies. The data

system assessment covered data collection, data sources, institutional arrangement on data collection and sharing protocols, existing MRV system and gaps analysis. Furthermore, the report detailed the level of capacity in terms of technical expertise in NDC development and tracking, and gaps that needs to be closed by Phase II to strengthen the institutional capacities. Lastly, and perhaps critical is establishing mechanisms to ensure that the synergies are created to align the NDC tracking activities with the updates to the GHG inventory including needs and gaps for effective compilation of the national inventory reports for the Energy and Transport sectors.

4.0. Institutional Arrangements for MRV (Energy & Transport)

MRV is fundamental to reporting the country's NDC in a transparent manner. The Conference of the Parties (COP) to the UNFCCC established MRV as the transparency framework for tracking the GHG emissions and the NDCs policy efforts. The main objectives of the MRV are to:

- Ensure greater transparency, accuracy and comparability of information with regard to climate change (e.g., GHG emissions, mitigation actions and climate support) in order to identify good practice, and allow an international benchmarking;
- Tracking Progress on NDCs
- Document mitigation achievements and inspire other party members;
- Monitor and quantified impacts of policies;
- Identifying gaps and international support needs; and,
- Facilitate access to international public and private finance.

The MRV covers three (3) areas being GHG emissions, NDCs and support (financial, technology, and capacity transfers) tracking.

In terms of institutional arrangements for the MRV, Botswana has well-functioning institutions for measuring and reporting some of the aspects included under the MRV framework mainly the GHG emissions. The country

has tasked the DMS to report the country's GHGs emissions as entailed in the country's biennial update reports (BURs), and National Communications (NCs) which contain updates of national GHGs inventories. In order to achieve this task, DMS has established the National GHG inventory team which constitutes key experts covering (energy, industrial processes and product use (IPPU), agriculture, waste, and land use and land use change and forestry (LULUCF), and waste). However, the key weakness of the national GHG inventory team during Phase I was lack of the QA/QC framework/plan for the GHG emissions inventory. During the stock-take it was discovered that the National GHG Inventory team has delegated the responsibility of the QA/QC coordinator to one of the members. Resultantly, a QA/QC plan for the latest GHG inventory for the Biennial Transparency Report I (BTR I) was developed and implemented as recommended under ICAT phase I. The uncertainty assessment is also carried out by the Inventory Coordinator and QA/QC coordinator. Inclusion of two additional personnel in the National GHG Inventory Team from the DoE and the Ministry of Lands and Agriculture in the team has been achieved as recommended in Phase I.

However, the only challenge that persists in the current team which was identified in Phase I and recommended for establishment is lack of expertise in data documentation/archiving. Hence, a GHG inventory data archiving system is needed and it should be supported by tools like the IPCC Inventory Software or EPA's Inventory Management Plan guidance. The system will maintain electronic records (cloud, servers) and potentially physical copies (USB) for security and accessibility as outlined in the UNFCCC Archiving System guidance.

Another MRV gap that was identified under Phase I is lack of structures (institutional arrangements) in place for NDC tracking. Since submitting the first NDC, the GoB has not been able to transparently and objectively track its policy efforts (mitigation and adaptation measures) aimed at reducing the GHG emissions and reducing vulnerability respectively. Under Phase I, it was recommended that a team be established or the existing National GHG

inventory team be strengthened for tracking the NDCs (mitigation and adaptation), however, this recommendation has not been implemented. Lastly, the government receives international assistance to implement the NDC mitigation and adaptation measures (conditional), however, the country has not established structure to track and report on this international assistance for NDCs.

5.0. Current Energy and Transport Data Systems

The MRV hinges on good quality, reliable and readily accessible data. The GHG emission inventory, NDC tracking (mitigation and adaptation) and the financial/technological assistance requires an enormous amount of good quality and reliable data hence the need for a robust data system. Similarly, for the institutions tasked with GHG emission inventory and NDC tracking, it is critical that the information/data is centrally stored for ease accessibility to the parties including the independent verifiers and reviewers, and third parties. Given the spatial coverage of the GHG emission sectors and the mitigation measures (e.g., household biogas plants, solar boreholes, solar geysers, rooftop solar, number of electric and hybrid vehicles (cars and boats), % share of goods transported by rail, elasticity of renewable energy consumption by transport, etc.), it is critical to ensure that effective data management systems and structures are put in place. Similarly, given the data quantity, a centralised data storage is of paramount importance.

Evidently, the GoB has established data system which is centrally managed by Statistics Botswana (SB). SB is a government parastatal that is responsible for the development and upkeeping of the National Statistics System (NSS). It is responsible for collection, processing, analysis, dissemination and archiving of official statistics across the country covering all the economic sectors including major emitters (energy and transport). The parastatal has a well-functioning data base for the activity data to facilitate construction of the GHG emission inventory. To cover all the sectoral data across the major economic sectors, SB has deployed its officers to major governmental departments to provide technical support in

data collection, and for easy collection of administrative data. Some of the data that are complied into reports that are produced by SB that are relevant to MRV include GHG emissions, electricity generation, coal consumption, petroleum imports and consumption, number of vehicles etc. The data is compiled into quarterly and annual reports and SB has an active portal for the activity data[1].

In terms of data quality, SB has developed a Botswana Data quality Assessment Framework (BDQAF) which guides its data quality and control protocols. The BDQAF has been developed in accordance with the UN Fundamental Principles of Official Statistics. One of the principles that underpins the BDQAF is accountability and transparency. The BDQAF is based on the underlying principle that the agency must present information according to scientific standards on the sources, methods and procedures of the statistics (UNECE, undated).

Therefore, the existence of the SB which maintains NSS for the country partially meets the requirement for the Transparency framework as it has a well-established and functional data portal. In fact, the agency produces and disseminate information on GHG emissions inventory, environment statistics and indicators, and other relevant activity data.

Despite the efforts of establishing an operational data system, there are some gaps and weaknesses that were identified under Phase I and recommended for strengthening. The national database that is managed by SB is limited and has significant gaps needed to implement the GACMO effectively. For tracking the NDC for the two high-impact sectors (energy and transport), highly granular consumption and technical data is required. According to UNEP Copenhagen Climate Centre (2023), GACMO calculates the abatement cost (the price of saving one ton of CO_2), therefore there is a need to collect not only "how much fuel was used" but also "what it cost" and "what the green alternative costs."

[1] Statistics Botswana | home (statsbots.org.bw)

Energy Sector data needs. In Botswana's context the focus is mainly how the country produces and distributes power, that is, supply and transformation. Data on the following indicators is required as prescribed by UNEP Copenhagen Climate Centre (2024):

- Fuel Inputs for Power: Total tonnage of coal consumed by Morupule A and B, plus any diesel used for emergency generators.
- Grid Emission Factor: The amount of CO_2 emitted per Megawatt-hour (MWh) generated.
- Transmission & Distribution (T&D) Losses: The percentage of electricity lost between the power plant and the consumer. (High losses mean more coal must be burned for the same result).
- Future Energy Mix: Planned capacity for new solar, wind, or gas projects (in MW) and their expected Capacity Factor (how many hours a day they actually generate power).
- Cost Data: The cost of producing 1kWh from coal vs. the cost of 1kWh from a new solar plant, as well as the investment costs ($/kW) for renewable energy technologies.

Transport Sector data needs. For the local context the focus is on demand and consumption, and data on the following indicators is required:

- Fuel Sales by Type: Annual volumes of Petrol (93/95) and Diesel sold at retail pumps (this is the proxy for transport activity).
- Vehicle Fleet Statistics: Total number of registered vehicles categorized by type (Passenger cars, Light Commercial Vehicles/Bakkies, Heavy Duty Trucks, Buses); and Average age of the fleet (older cars are usually less fuel-efficient).
- Mileage Data: Average annual distance travelled (km) per vehicle type
- E-Mobility Assumptions: For "Green" scenarios, the cost of an Electric Vehicle (EV) vs. an Internal Combustion Engine (ICE) vehicle, and the efficiency of EV charging is required.

A comprehensive gap analysis of the energy and transport sectors was conducted to determine data readiness for the GACMO model. Following a rigorous desk review and technical consultations with key institutional stakeholders—including the Department of Energy (DoE), and Statistics Botswana—the current state of data availability was mapped against the model's input requirements. The resulting data landscape and identified deficiencies are synthesized in Table 1.

Table 1: Status of GACMO data availability for the energy and transport sectors

GACMO Data Category	Specific Data Need	Status	Source/Stakeholder	Identified Gap / Action Required
ENERGY SECTOR	Fuel Inputs for Power	Available	BPC / Morupule Coal Mine	High-level tonnage available; requires breakdown of diesel used specifically for emergency backup (Orapa/Matshelagabedi).
	Grid Emission Factor	Partial	BPC / DoE	Historical factors exist but require updating to reflect recent Morupule B efficiency and import mix (ESKOM/SAPP).
	T&D Losses	Available	BPC	Technical and commercial losses are tracked but need to be isolated for GACMO transformation modules.
	Future Energy Mix	Partial	BERA / Integrated Resource Plan (IRP)	Capacities are planned (IRP 2020-2040), but specific Capacity Factors for new solar/wind pilots are based on estimates, not local data.
	Cost Data	Partial	BERA / IPPs	Pula/kWh tariffs are available; however, Investment Costs ($/kW) for local solar projects often remain proprietary and require estimation.
TRANSPORT SECTOR	Fuel Sales by Type	Available	Botswana Oil / BURS	Total annual volumes for Petrol and Diesel are high-quality; needs mapping from "total sales" to specific "Road Transport" use.
	Vehicle Statistics	Partial	DRTS / Statistics Botswana	Total registrations are known, but fleet segmentation by Engine Capacity and Fuel Type is not yet fully digitized for the entire fleet.
	Fleet Age Profile	Partial	DRTS	Registration years are available for new entries; historical fleet age distribution remains a significant data gap.

	Mileage Data	GAP	Statistics Botswana / DRTS	Critical Gap: No national survey currently tracks "Average Annual Kilometers" per vehicle class. Expert judgment is currently used.
	E-Mobility	GAP	Ministry of Transport	Local costs for EV adoption and charging efficiency in Botswana's climate are not yet documented.

5.1. ICAT Renewable Energy Methodology data needs

To ensure Botswana's transition to renewable energy is transparent and verifiable, the ICAT Renewable Energy Methodology provides a framework to assess the Greenhouse Gas (GHG) impacts and sustainable development benefits of energy policies. This assessment requires specific data clusters to calculate the shift from fossil-fuel-based generation to cleaner alternatives.

The following data needs are mapped directly from the ICAT Renewable Energy Methodology (2020), and adapted for Botswana's institutional landscape:

1. GHG Impact Assessment (The Baseline vs. Policy Scenario): define the emissions that would have occurred without renewable energy intervention:
    - Grid Emission Factor (GEF): It requires data on the Operating Margin (the emission intensity of existing plants like Morupule B) and the Build Margin (the intensity of the next planned units) (ICAT, 2020a).
    - Fuel Consumption and Net Calorific Values: Precise data on the quality of coal from Morupule Coal Mine is required to determine the specific carbon content, rather than relying on IPCC (2006) defaults.
    - Displaced Generation: Historical data from the Botswana Power Corporation (BPC) on which power plants (or imports) are reduced when solar energy is added to the grid (ICAT, 2020a).
2. Policy Implementation Tracking: Tracking the actual progress of policies (e.g., Botswana's Integrated Resource Plan (IRP)) requires granular operational data:
    - Installed Capacity vs. Actual Generation: The nameplate capacity (MW) of new solar or wind farms versus the actual electricity (MWh) delivered to the national grid (Government of Botswana, 2021).

- Capacity Factor: The efficiency of solar plants in Botswana's high-irradiance climate. This is essential for the "Technical Verification" part of the MRV system.
- Project-Specific Costs: Capital Expenditures (CAPEX) and Operating Expenditures (OPEX) for new Independent Power Producers (IPPs). This data is often held by BERA and is used to calculate the cost-effectiveness of the policy (ICAT, 2020a).

3. Sustainable Development (Non-GHG) Impacts: The ICAT framework mandates tracking co-benefits to ensure the "Just Energy Transition" is documented (ICAT, 2020b). Data on the following indicators is required to facilitate reporting on co-benefits:
   - Employment Data: Total number of jobs created by renewable energy projects, categorized by gender and skill level (collected via Statistics Botswana labour surveys).
   - Energy Access: Number of households or businesses gaining access to electricity through off-grid or mini-grid solar installations (Government of Botswana, 2021).

5.2. ICAT Transport Pricing Methodology data needs

The ICAT Transport Pricing Methodology provides a framework for assessing GHG and sustainable development impacts of policies that change the cost of transport—such as fuel taxes, carbon taxes, vehicle registration fees, or road tolls. In the context of Botswana, applying this methodology requires moving from aggregate fuel sales to understanding the behavioural response of vehicle owners to price signals. The following data needs are categorized based on the ICAT Transport Pricing Methodology (2020) requirements, tailored to the Botswana's setting:

1. Baseline Data (The Pre-Policy State): To determine the impact of a price change, there is a need to first establish a robust baseline of fuel consumption and fleet activity:

- Fuel Price Structure: A detailed breakdown of the retail price of petrol and diesel, including existing levies (e.g., MVA Fund, and National Petroleum Fund.
- Price Elasticity of Demand: It measures how much fuel consumption in Botswana drops when prices rise by 1%. This often requires historical longitudinal data, possibly from Statistics Botswana and the Ministry of Finance to calculate local sensitivity.
- Vehicle Fleet Segmentation: Total number of vehicles by fuel type and efficiency class. This allows the model to predict if users will switch to more efficient cars when fuel prices increase.

2. Policy Implementation Data: This tracks the specific changes introduced by the government, such as an increase in the fuel levy, among others:
   - Policy Coverage: Which fuels and vehicle types are affected? For example, does a fuel levy apply only to private cars or also to heavy-duty freight?
   - Tax/Subsidy Levels: The exact monetary value of the price change (e.g., Pula per litre or Pula per CO_2/km).
   - Revenue Recycling Data: Information on how the tax revenue is used. The ICAT methodology emphasizes that if the revenue is used to fund solar projects, the "Mitigation Impact" is much higher.
3. Activity Data and Emission Factors:
   - Average Annual Mileage: Estimated kilometres travelled per vehicle category. This is currently a data gap in Botswana and requires "Odometer Readings" from DRTS or specialized surveys.
   - Emission Factors (EF): The carbon content per litre of fuel. While IPCC (2006) defaults are often used, local testing of fuel samples at Botswana Oil can provide more precise, nationally-specific factors.

5.3. Status ICAT Renewable Energy Methodology data availability

This section provides a comprehensive gap analysis for Botswana's energy sector, specifically aligned with the ICAT Renewable Energy Methodology. It maps the technical requirements against the current institutional landscape to identify where data pipelines need strengthening (Table 2).

Table 2: Detailed Gap Analysis for ICAT Renewable Energy Methodology for Botswana

Data Category & Need	Current Availability Status	Source / Stakeholders	Identified Gap	Action Required
1. GHG IMPACT ASSESSMENT				
Grid Emission Factor (GEF)	Partial	BPC, Dept. of Energy (DoE)	Lack of an annually updated Build Margin; GEF is often calculated on an ad-hoc basis.	Standardize GEF calculation using UNFCCC Tool 07 to reflect the evolving mix of domestic coal and SAPP imports.
Fuel Consumption & Calorific Values (NCVs)	Low / Partial	Morupule Coal Mine, BPC	High reliance on IPCC (2006) default values instead of lab-verified national carbon content for Morupule coal.	Conduct seasonal lab analysis of Morupule coal to establish a National Emission Factor for local coal combustion.
Displaced Generation	Gap	BPC (System Control)	No clear methodology to identify which source (coal vs. import) is reduced when solar generation peaks.	Establish a Merit Order Data Feed from BPC to track real-time displacement of fossil fuels by renewables.
2. POLICY TRACKING				
Installed Capacity vs. Actual Generation	Available	BPC, BERA	Data exists in monthly reports but is not integrated into a central, real-time MRV dashboard.	Automate data harvesting from BPC and IPP billing meters for transparent, real-time generation tracking.
Capacity Factor	Partial	DoE, Private IPPs	Technical performance of solar PV in Botswana's high-heat climate is not verified against international benchmarks.	Create a performance database to verify the "technical efficiency" of solar installations as part of the MRV system.
Project-Specific Costs (CAPEX/OPEX)	Gap / Sensitive	BERA, IPPs	Financial data for Independent Power Producers (IPPs) is often restricted due to commercial confidentiality.	Integrate "Financial Transparency" clauses into future Power Purchase Agreements (PPAs) for anonymized data sharing.

3. SUSTAINABLE DEVELOPMENT				
Employment Data (Gender/Skill)	Partial	Statistics Botswana	National labor surveys do not specifically "tag" jobs within the Renewable Energy sector.	Update ISIC codes in labor surveys to uniquely identify and track "Green Jobs" created by RE projects.
Energy Access (Off-grid/Mini-grid)	Partial	Ministry of Energy, BPC	Data on household connections via private solar mini-grids is fragmented and often excluded from national stats.	Implement a mandatory reporting framework for off-grid providers to report new connections to the National Statistical System (NSS).

5.4. Status of ICAT Transport Pricing Methodology data availability

This gap analysis is designed to support the implementation of the ICAT Transport Pricing Methodology. In Botswana, the transport sector is a major fuel consumer and emission source, a move from "total fuel sold" to "policy-driven behaviour change" is critical for the NDC tracking. The following table maps the data requirements against the current technical landscape of Botswana (Table 3).

Table 3: Data Readiness and Gap Analysis for the implementation of ICAT Transport Pricing Methodology for Botswana

Data Category & Need	Current Availability Status	Source / Stakeholders	Identified Gap	Action Required
1. BASELINE DATA				
Fuel Price Structure	High	BERA, Botswana Oil	Excellent visibility of the "Botswana Unit Rates." Levies (MVA, NPF, and RDF) are clearly disaggregated.	Formalize a recurring digital feed of price adjustments to the Directorate's MRV system.
Price Elasticity of Demand	Low	Statistics Botswana, Ministry of Finance	No official, country-specific "Elasticity Coefficient" exists for Botswana's unique transport market.	Conduct an econometric study using historical fuel prices and household expenditure data from the Botswana Multi-Topic Household Survey (BMTHS).
Vehicle Fleet Segmentation	Partial	DRTS, Statistics Botswana	Segmentation by body type (van, car) is available, but Efficiency Class (gCO_2/km) is not yet mapped to the fleet.	Cross-reference DRTS registration data with international vehicle technical databases to assign emission classes.
2. POLICY IMPLEMENTATION				
Policy Coverage	High	Ministry of Finance, BERA	Clear legal mandates on which fuels/sectors are taxed (e.g., the Carbon Tax at border entry).	Map "Exemptions" (if any) for agricultural or industrial fuel use to refine the transport-specific impact.
Tax / Subsidy Levels	High	BURS, Ministry of Transport	Precise Pula/Litre values for levies are documented in the Government Gazette.	Track the "Real Value" of these taxes over time by adjusting for inflation to assess their true "deterrent" effect.

Revenue Recycling Data	Low	Ministry of Finance, NPF	Revenue is collected centrally; however, there is no public tracking of funds recycled into Green Transport (e.g., BRT or EV charging).	Establish a "Climate Expenditure Tagging" system to track how fuel levies are reinvested into mitigation projects.
3. ACTIVITY & EMISSION FACTORS				
Average Annual Mileage	Gap	DRTS, Statistics Botswana	Critical Gap: No national data exists for "km travelled per year" per vehicle category.	Pilot a "Mileage Collection" program during the annual Vehicle License Renewal process at DRTS offices.
Emission Factors (EF)	Partial	Botswana Oil, IPCC	Currently relies on IPCC (2006) default factors. Local carbon content of imported fuel is not routinely tested.	Collaborate with Botswana Oil to perform periodic lab testing of fuel samples to establish Botswana-Specific Emission Factors.

Consequently, from this snapshot data requirement and availability status, it can be deduced that there are some data gaps to effectively apply the GACMO for GHG projections and policy impacts on GHG emissions.

Some of the factors that contributes to data gaps for NDC tracking include lack of nationally agreed indicators which should guide SB on data collection. Due to lack of agreed indicators, it implies that SB lack guidance from the DMS on additional data to collect to enable NDC tracking. Lack of indicators for the NDCs implies that the country lack national data on critical NDC mitigation measures and accurately measuring petroleum price changes.

Another critical aspect that was identified under Phase 1 was lack of data sharing modalities to facilitate data sharing amongst institutions. Institutions such as National Development Bank, private sector have data on mitigation measures (e.g. solar boreholes installed, solar streetlights, and biogas production). However, this data is difficult to access due to lack sharing protocols. Under Phase I, it was recommended that a data management strategy should be formulated and implemented at Statistics Botswana as part of operationalizing the BSDS I. This will facilitate efficient data sharing and an enhanced data management which will strengthen the country's capacity to meet the transparency framework. Statistics Botswana developed a Data Management Strategy between 2019 and 2021. However, it was never officially published as its scope was limited to the organization and the National Statistical System (NSS).

Lastly, Phase I recommended the development of the NDC tracking templates which were eventually developed. The tracking templates detailed the sectoral mitigation measures, their Key Performance Indicators to be reported and automatically generate the GHG emission reduction from government efforts. However, the developed NDC tracking tools have not been adopted by the country for implementation and hence no data has been collected on the indicators to this point. Similarly, no comprehensive study has been undertaken on price elasticity for petroleum products to enable application of ICAT methodologies.

Consequently, the data gaps implies that there will be challenges in applying GACMO and the ICAT renewable energy and transport methodologies.

6.0. NDC Tracking and Monitoring Framework

NDC is at the heart of the Paris Agreement to stabilize the global GHG emissions. NDC tracking is a mandatory element of the Biennial Transparency Report (BTR) under Section III of the Modalities, Procedures, and Guidelines (MPGs) of the UNFCCC. It is critical in assessing party members progress on climate commitments under the Paris Agreement. Its main objective is to ensure that party members provide clear, consistent, and transparent information on NDC implementation and achievement as per the Paris Agreement and its Transparency framework. Party members are mandated to update and submit their NDC every 5 years (UNFCCC, 2020). The reporting process that are critical for this analysis include: Step 1 communicating the NDC; Step 2: Submit BTR to track progress on (GHG inventory; tracking progress towards NDC, amongst others).

There are existing tools that have been developed to aid the party members to tracking NDC and the GHG emissions. These include GACMO (Greenhouse Gas Abatement Cost Model); ICAT Renewable Energy & ICAT Transport Pricing methodologies mainly WACC, LCOE) and price elasticities for transport and the FAO NDC tracking template.

The key priorities areas for NDC tracking including data availability to apply the recommended models (GACMO, price elasticity for transport (petroleum products), alignment of the country's NDCs indicators to the GACMO data needs and conversant of the GHG inventory team to apply GACMO.

Under ICAT phase 1, to enhance and build the institutional capacities, GACMO training exercise was undertaken with the relevant personnel within various governmental departments and the private sector, including the national GHG inventory team. The GACMO entailed data needs and

inputting the data for GHG emission projections, policy impacts on GHG emissions amongst others.

Key priorities areas for NDC tracking including data availability, expertise with the institutions and availability of the MRV frameworks. As highlighted under relevant sections, there are gaps in data availability to effectively track the NDC accurately. This is due to lack of nationally agreed indicators to enable specific data collection of these indicators.

Another critical aspects for NDC tracking is the MRV framework. One of the critical aspects of the MRV framework is the establishment of domestic MRV. The Domestic MRV entails systems in place to internally measure and report the GHG and the NDC tracking. As alluded to, the country has a fully functioning and sectoral representative nationally GHG inventory team which compiles the National Inventory Document (NID), National Inventory Report (NIR), and the GHG Inventory chapter for both the National Communications (NCs) and Biennial Transparency Reports (BTRs). However, national domestic MRV structure lack NDC tracking structure. Since, the submission of the first NDC, the country has not been able to transparently track its mitigation and adaptation policy efforts (NDC tracking). Furthermore, it is difficult for verification of the NDC measures due to lack of organised data management systems.

Further analysis revealed lack of defined organisational mandates in respect to NDC tracking and reporting. There are no terms of reference (ToRs) for the institutions nor the existing teams for NDC tracking and reporting. One of the recommendations that was made under Phase 1 was for the development of the terms of reference for NDC tracking for the existing team or institution.

7.0. Institutional knowledge and expertise

Institutional knowledge and expertise is critical for enhancing and achieving the Paris Agreement and its transparency framework. An assessment made by ICAT Phase I revealed gaps in NDC tracking, methodologies and

knowledge of the NDCs. The first gap that was identified was limited knowledge on the NDCs and the MRV/ETF. Some of the stakeholders indicated lack of knowledge on the NDC and tracking requirement. However, this gap was closed through the intense training that was undertaken with the stakeholders. Similarly, expertise in the development of the NDC and tracking was assessed under Phase I stocktaking exercise. The lack of gap in developing the NDC was closed through training.

Critical to this current assessment was whether the stakeholders were familiar with GACMO and could expertly apply it to either undertake GHG emission projections or NDC tracking.

Consultation on the institutional knowledge and expertise on GACMO and ICAT methodologies was undertaken with the key stakeholders. The stakeholders who responded indicated that they have attended the GACMO training. However, 100% noted that they have not had the opportunity to apply GACMO. The main reason that was given for not applying or practising GACMO was that there was no opportunity to apply it. Specifically, the National GHG Inventory team noted that if the NDC tracking task could been assigned to them, they would have applied GACMO. The response from the stakeholders revealed a significant gap of not implementing recommendations that were meant to ensure continuity of ICAT Phase I. For instance, under ICAT Phase I it was recommended that the GHG inventory team be strengthened and tasked with NDC tracking. If this recommendation was implemented, the institution would have applied GACMO in NDC tracking. Consequently, it can be concluded that the institutions lack application of GACMO and have no technical expertise on GACMO and other ICAT methodologies.

8.0. Leverages and alignment of NDCs tracking and GHG inventory

NDC tracking constitute two critical components being adaptation measures and mitigation measures. The mitigation measures are efforts

that the government deliberately operationalise to reduce the GHG emission. Hence at the national level, NDC tracking is merely tracking the GHG emissions and removal. It is thus imperative that leverages are created to ensure that GHG emission inventory/projections and the NDC tracking are harmonised for consistency and efficiency. In order to achieve this, the National GHG emission inventory team should be tasked with GHG emission inventory, projections and the NDC tracking. The advantage of using the same team lies in optimising the expertise available. Additionally, using the same team will ensure efficiency as the team will be familiar with the GHG data.

Another area of leverage is on the use of methodologies. GHG emission projections relies on the approved ICAT methodology (GACMO) which is the same method that can be used for NDC Tracking.

Lastly, GHG emission projections entail estimating the GHG emissions reductions and removals. Hence, this calls for the need to leverage on the existing structure, personnel and systems when undertaking GHG emissions projections and undertaking NDC tracking.

9.0. Conclusions

Based on the findings from the stocking taking exercise the following conclusions were made:

- The country has existing data management system in place which is mainly dominated by Statistics Botswana.
- There is fairly and reasonable existence of data which can be used to support NDC tracking tools mainly GACMO.
- There are no structure in place to support NDC tracking as the recommendation from ICAT Phase I of strengthening National GHG inventory team was not implemented.
- Various institutions have been trained on GACMO and the NDC tracking tools, however, institutions have not been afforded the opportunity to apply the methodologies

- The knowledge and skills gained from Phase I regarding training has been eroded lost due to lack of practice.
- GHG emission projections and NDC tracking have strong synergies and area of leverages that need to be harnessed by ensuring that the same team that undertake GHG emission inventories is tasked to undertake NDC tracking.

10.0. Recommendations

Based on the findings from the stock-taking exercise, the following recommendations and actionable activities are designed to bridge the key gaps/needs related to the NDC development and tracking in the Energy and Transport sectors:

1) To address the lack of a formal structure for tracking and reporting international assistance for NDCs, there is a need to implement a systematic framework based on the ICAT methodology. This involves transitioning from ad-hoc reporting to a permanent MRV system. This will require a multi-phased approach:
   - Establish Institutional Arrangements: defining the legal and organizational structures necessary for data flow by assigning lead agencies, defining objectives, and formalizing data sharing. It can be jointly led both the Ministry of Finance and Ministry of Environment and Tourism.
   - Develop standardized methodologies: it ensures that data is consistent and meets the ETF requirements of the Paris Agreement. It will involve the selection of tracking methods, designing reporting templates, and should be tailored to national context.
   - Implement data collection and management: a robust system will active engagement with the data providers and users of climate finance. It entails regular consultations with donors and private sector, systematize data collection with interfaced digital systems.
   - Ensure iterative improvement: the tracking structure must evolve based on reporting experience. The results from conducting stock-

take must be used to adjust templates and methodologies, ensuring they remain relevant to the national context.

2) Formalize and sustain GHG inventory management roles. While the delegation of a QA/QC coordinator is a success, the roles for QA/QC and uncertainty assessment should be formalized to ensure institutional memory beyond the current team members.

3) Establish a Robust National Archiving Framework. To address the lack of expertise in documentation, the country must move from ad-hoc file saving to a formal Archiving System that aligns with UNFCCC guidance. This system should serve as the "single source of truth" for all activity data, emission factors, and calculation sheets.

4) Integrate Standardized Documentation Tools. The inventory team should transition toward using specialized tools like the IPCC Inventory Software or EPA's Inventory Management Plan (IMP) guidance to automate and structure the archiving process.

Actionable activities:

- Phase 1: Capacity Building & Tool Selection
  - Targeted Training Workshops: Organize technical training for the National GHG Inventory team specifically on data documentation and archiving best practices, focusing on the requirements of the ETF.
  - Tool Customization: Adopt and configure the EPA IMP template to create a country-specific manual that dictates exactly how and where data is stored.
- Phase 2: System Development & Infrastructure
  - Setup Hybrid Storage Infrastructure: Configure secure cloud storage and dedicated servers for real-time access and version control.

- Physical: Establish a protocol for secondary backups on physical media (e.g., encrypted USBs) to be stored in a secure location as a contingency.

- Phase 3: Institutionalization & QA/QC Integration
  - Update QA/QC Plan: Amend the existing QA/QC plan to include "Archiving Checks" as a mandatory step before the finalization of the Biennial Transparency Report (BTR).
  - Define Archiving SOPs: Develop Standard Operating Procedures (SOPs) that outline the chronological steps for archiving, including who is responsible for uploading data and how often backups are performed.

5) One of the most critical gaps in Botswana's transport data is the lack of Average Annual Mileage per vehicle. To bridge this gap in the short term, the ICAT Phase II project should adopt a top-down method. Instead of waiting for physical odometer readings, the team can estimate total distance travelled by dividing the total fuel consumed (provided by DoE and BERA) by the average fuel efficiency of the fleet. By using IPCC Tier 1 default efficiency factors, the project can generate a reliable proxy for national mileage. This allows for the calculation of Passenger-Kilometres (PKMs) without the need for immediate, resource-heavy road surveys.

6) Given the timeline constraints, the project should adopt value transfer proxies in the absence of country-specific fuel price elasticity of demand. This involves using elasticity coefficients from peer Southern African countries or international meta-analyses. Specifically, standardizing models using the Dahl (2012) regional coefficients (-0.65 for Petrol and -0.45 for Diesel) ensures the ex-ante assessment remains technically defensible and aligned with ICAT's recommendations for middle-income countries.

7) In the absence of country-specific emission factors, derived from local laboratory results for imported fuel, the project should strictly adhere to IPCC Tier 1 default emission factors. Standardizing on the 2006 IPCC Guidelines for Net Calorific Values (NCVs) ensures that Botswana's report remains comparable with international benchmarks. This prevents delays and ensures that the GACMO and ICAT models are perfectly harmonized using the same foundational carbon constants.

8) Another significant data gap that has been identified which is critical for applying the ICAT RE methodology is the household solar PV system and their capacity. To close this data gap and apply the ICAT methodology, number of applications to Botswana Power Corporation by the households should be used. However, this may underestimate the actual number of households with solar PV system.

11.0. References

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12.0. Annex 1

The National GHG Inventory Team:

Last Name:	Affiliation
Ramaphane, G	University of Botswana
Dintwa, KF	Statistics Botswana
Nkoni, G	University of Botswana
Phunyuka, G	Department of Forestry and Range Resources
Likuku, A	BUAN
Baleseng, L	Ministry of Agriculture
Setlhare, OJ	Department of Energy
Khumalo, M	Department of Environmental Protection

13.0. Annex 2

Questionnaire for Stock taking exercise for The Initiative for Climate Action Transparency (ICAT) Botswana Project Phase II

This questionnaire is developed for the ICAT Botswana Project Phase II inception stage. It is a stock taking exercise with the objective of assessing the status of data collection, data sources, processing, data management, institutional arrangements in place, and key priorities for the Measuring Reporting and Verification (MRV) system, projections, and Nationally Determined Contribution (NDC) tracking in the Energy and Transport sectors. Furthermore, it aims at assessing the following:

- The existing capacity across sectors and key gaps/needs related to the NDC development, identified indicators, projections and other technical work that has been done to this point.
- Knowledge and capacity in the country, training needs, and who should be trained.

The information gathered from this analysis will be treated with utmost confidentiality.

Name:	
Institution:	
Email:	
Phone:	

1. Kindly indicate the MRV aspects your institution participate in:
   □ NDC development ___
   □NDC tracking ___
   □ GHG inventory ___
   □ Data management for MRV ___
   □ GHG projections ___
2. Did your institution participate in ICAT Phase I? Yes ___ / No ___
3. Which aspect of MRV did ICAT Phase I improve?
   □ Data collection and management ___
   □ Institutional arrangement for MRV ___
   □ GHG inventory ___
   □ NDC tracking ___

4. State how the improvements were made _____
   _____
   _____
5. Was your institution represented in GACMO[2] (Greenhouse Gas Abatement Cost Model) training offered during Phase I? Yes ___ / No ____
6. If Yes, has your institution applied GACMO _____
   _____
7. Did you encounter any challenges in the application of GACMO? If yes, kindly state the challenges encountered
   _____
   _____
   _____
8. If NO, kindly state the reasons for not using GACMO in your institution
   _____
   _____
9. Kindly indicate whether there is data availability for the following
   □ NDC tracking ____
   □ GHG projections ____
   □ Estimating petroleum products elasticity ____
   □ Renewable energy ____
10. Has the Phase I resulted in the improvement of data availability
    _____
    _____
    _____
11. Are the current institutional arrangement creating a conducive environment for NDC tracking, GHG projection
    If yes, kindly state how
    _____
    _____
    _____
    _____
12. One of the output of ICAT phase I was development of NDC Tracking tools, has your organisation applied the tools Yes ___ / No ___
13. If yes, how user friendly were the tracking tools
    _____
    _____
    _____
14. If no, give reasons for not using the NDC tracking tools
    _____

[2] **GACMO** (Greenhouse Gas Abatement Cost Model) is a greenhouse gas emissions projections tool developed over more than twenty years by the UNEP Copenhagen Climate Centre.

_____

_____

_____

15. Kindly indicate MRV areas that Phase II must prioritize

_____

_____

_____

THANK YOU.