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ICAT Initiative for Climate Action Transparency

Consultancy Services for Development and Implementation of a Nationally Determined Contribution (NDC) Tracking and Monitoring Framework for Transport and Waste Sector Policies and Measures

Deliverable K: Database of NDC mitigation and adaptation actions associated with the Transport and Waste sectors

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Abbreviations

GHG	Greenhouse Gas
GHGMI	Greenhouse Gas Management Institute
GKMA	Greater Kampala Metropolitan Area
ICAT	Initiative for Climate Action Transparency
iMRV	Integrated Monitoring Reporting and Verification
IPCC	Intergovernmental Panel on Climate Change
MoLHUD	Ministry of Lands, Housing and Urban Development
MRV	Monitoring Reporting and Verification
MtCO2e	Metric tons of carbon dioxide equivalent
MWE	Ministry of Water and Environment
MWE-CCD	Ministry of Water and Environment, Climate Change Department
NDC	Nationally Determined Contribution
NMT	Non-Motorised Transport

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Executive summary

This report has been prepared as a companion to the database of adaptation and mitigation activities/actions stipulated in Uganda's updated NDC, specifically associated with the Transport and Waste sectors. Upon approval, this database will be incorporated into the Integrated Monitoring Reporting and Verification (iMRV) system under the Ministry of Water and Environment.

This is under the broader objective of implementing the NDC tracking and monitoring framework at national and local government levels.

The report provides a brief background of the project, the project objectives and the project deliverables; describes the data collection process for the database and the NDC tracking framework; and the process of development of the database.

The databases of adaptation and mitigation activities/actions for both the transport and waste sectors are attached as two separate annexures to this report, in the Excel file format.

1 Introduction

1.1 Project background

The Government of Uganda, through the Ministry of Water and Environment - Climate Change Department (MWE-CCD) has received financing from the Initiative for Climate Action Transparency (ICAT) through the United Nations Office for Project Services (UNOPS). Part of these funds have been earmarked for the development of a Nationally Determined Contribution (NDC) Tracking and Monitoring Framework for Transport and Waste Sector Policies. The project's main objective is to strengthen Uganda's capacity to expand its National Greenhouse Gas (GHG) Inventory Management System and operationalize an NDC tracking framework, allowing the country to track progress towards its NDC targets under the 2015 Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC).

The primary aim of the Paris Agreement is to hold "the increase in global average temperature to well below 2°C above pre-industrial levels" and to pursue measures "to limit the temperature increase to 1.5°C above pre-industrial levels" (UNFCCC, 2015). To achieve this goal, each country is required to develop and implement its national climate action plan, known as NDC, with specific targets and actions to reduce greenhouse gas (GHG) emissions and adaptation measures to the impacts of climate change. Uganda, as a party to the Paris Agreement, filed its Intended NDC (INDC) in October 2015, its first NDC in September 2016 and its Updated Nationally Determined Contribution in September 2022, in accordance with Article 4 of the Paris Agreement.

1.2 Project objectives

The objectives of this project are:

i. To strengthen the national capacity to track and monitor NDC actions in the Transport and Waste sectors

ii. To develop an NDC tracking and monitoring framework for the Transport and Waste sectors

iii. To develop a roadmap for the implementation of the NDC tracking framework; and

iv. To conduct training workshops to build awareness on the operationalisation of the tracking framework.

v. The developed NDC tracking and monitoring framework shall be used to oversee and evaluate Uganda's progress towards meeting its NDC targets in the transportation and waste sectors.

1.3 Scope of deliverables

This assignment comprises four main components which are as follows;

i. Project inception;

ii. Developing an NDC tracking and monitoring framework for transport and waste policies and measures;

iii. Piloting the implementation of the developed NDC tracking and monitoring framework at the national and local government levels; and

iv. Project validation and close-out

The seven key deliverables are outlined in Table 1. For each deliverable, the main tasks and the sub-tasks have been listed.

1.4 Project deliverables

Table 1-1: Summary of the project deliverables

Task	Sub-task	Deliverable
1. Project inception	1.1. Inception meeting	Inception report
2. Development of a NDC tracking and monitoring framework for the Transport and Waste sectors	2.1. Identify the adaptation and mitigation activities in the NDC associated with the Transport and Waste sectors. Develop, together with stakeholders and other project consultants, a draft set of indicators for tracking adaptation and mitigation actions and develop a NDC tracking framework for the Transport and Waste sectors	NDC tracking framework for the Transport and Waste sectors
	2.2. Develop data collection templates for activity data to track the identified NDC actions in the Transport and Waste sectors.	Data collection templates
3. Implement NDC tracking and monitoring framework at national and local government level	3.1. Create a database of adaptation and mitigation activities/actions associated with the Transport and Waste sectors and incorporate actions into iMRV system.	Database of key adaptation and mitigation activities
	3.2. Assess the availability of relevant data and existing institutional arrangements for collecting them; identify data, institutional and resource gaps to track the NDC actions; evaluate how the existing MRV platform can be used to manage data collection and processing for the indicator sets; develop a draft roadmap for tracking NDC actions and indicators for the Transport and Waste sectors; conduct a validation workshop for the roadmap; and finalize the roadmap. Pilot and test the applicability of the developed roadmap for both sectors	Roadmap for the implementation of the NDC tracking system in the Transport and Waste sectors
	3.3. Hold 2 training sessions with relevant stakeholders and present the tracking framework and build awareness and assist government in operationalizing the framework.	NDC tracking framework training workshop reports

4. Validation and project close-out	4.1. Facilitate and participate in a 1-day project validation workshop and work with MWE-CCD and other project consultants to compile a workshop report along with a final project report highlighting the lessons learnt.	Project validation workshop report and final report highlighting lessons learnt

1.5 Purpose of the report

This report is a result of activity 3.1 of this project: Create a database of adaptation and mitigation activities/actions associated with the Transport and Waste sectors and incorporate actions into iMRV system (see Table 1). It is a companion to the database of key adaptation and mitigation activities for Transport and Waste sectors which has been developed by the Consultant.

This is under the broader objective of implementing the NDC tracking and monitoring framework at national and local government level.

Upon approval, the adaptation and mitigation activities/actions identified in the Transport and Waste sectors will be incorporated into the iMRV system.

2 Data Collection Approaches

The data included in the database was collected through two main approaches: review of previous relevant research studies and project reports, and consultation of a wide range of primary and secondary stakeholders. These approaches were aimed at collection of relevant secondary datasets from stakeholders or publicly available data sources.

2.1 Literature Review

A comprehensive desk study was undertaken to review all the context and subject-relevant literature for this project. This involved review of existing literature relating to the Uganda's updated NDC, analysis of Uganda's NDC commitments in the transport and waste sectors, identification, and review of existing monitoring systems for tracking transport and waste sector mitigation and adaptation measures, and their respective data collection tools and methods.

2.1.1 National status quo on GHG mitigation and adaptation in the transport and waste sectors

2.1.1.1 Introduction

Globally, the transport and waste sectors are significant contributors to GHG emissions, accounting for approximately 20% of the global GHG emissions. [1]

[1] Hannah Ritchie (2020), "Sector by sector: where do global greenhouse gas emissions come from?", Published online at OurWorldInData.org, https://ourworldindata.org/ghg-emissions-by-sector; Intergovernmental Panel on Climate Change (IPCC) (2014), Climate Change 2014: Synthesis Report, Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)], Geneva, Switzerland, https://www.ipcc.ch/report/ar5/syr/

In Uganda, the transport and waste sectors are highly vulnerable to the impacts of climate change.

In the transport sector, this is due to the heavy reliance on road infrastructure for freight and passenger transportation, which is vulnerable to extreme weather events such as heavy rainfall, flooding, and landslides which damage the road surfaces, bridges, and other transport infrastructure, leading to delays, detours, and road closures. The transport sector in Uganda also faces challenges in terms of resources, funding, and technical capacity. Limited financial resources hinder the implementation of climate-resilient infrastructure and maintenance. Addressing the vulnerability of the transport sector to climate change in Uganda requires a combination of strategies, including climate-resilient infrastructure planning, improved road maintenance practices, investment in alternative transport modes, and capacity-building efforts.[2] However, the successful implementation of such interventions will require a robust monitoring and tracking system for transport activity in the country, and the resulting GHG emissions. This is also critical for the development of early warning systems for adaptation to climate change impacts.

The waste sector in Uganda encompasses waste management practices, including waste collection, disposal, and recycling, and its vulnerability arises from the sector's dependence on infrastructure, waste generation patterns, and the potential amplification of environmental risks. The vulnerability of the waste sector to climate change in Uganda is a pressing concern due to the sector's susceptibility to various climate related impacts. For instance, changes in weather patterns, such as increased rainfall and temperature variations, can influence waste generation rates and composition. Higher temperatures may lead to increased food spoilage and organic waste generation, while heavier rainfall can result in more waste contaminated with water and contribute to overall waste generation. In addition, climate change induced extreme weather events like heavy rainfall and flooding damage landfill sites and waste disposal facilities. These events disrupt waste management systems, leading to the spread of waste, and contaminating surrounding environments. Similarly, inadequate waste management practices, especially in the face of changing climate conditions, result in air and water pollution. Climate impacts like flooding carry waste and pollutants into water bodies, posing risks to aquatic ecosystems, human health, and overall water quality. There are also health risks where climate change increases health risks associated with poor waste management practices. Flooding and increased temperatures create breeding grounds for disease vectors such as mosquitoes, leading to the easier spread of vector-borne diseases in communities near waste sites.[3]

2.1.1.2 Emission trends in the transport sector

The energy sector, which encompasses the transport sector, accounted for 10.8% of Uganda's GHG emissions in 2015. [4]

[2] UNHSP (2009), Assessment of Cities and Climate Change in Kampala and Uganda

[3] African Development Bank (ADB) (2008), Kampala Sanitation Programme, Environmental and Social Impact Assessment Summary (ESIA)

[4] Government of Uganda (2020), National Greenhouse Gas Inventory (NIR) Report for 2005-2015

Uganda's transport system can be divided into five main sectors including road transport, rail transport, air transport, inland water transport, and cross border water transport. Road transport is the primary mode of transport, with over 95% of all traffic carried by this mode. In 2018/2019, approximately 96% of both freight cargo and passenger traffic was transported using road transport. According to a nation-wide data collection exercise conducted by GIZ Uganda in 2021 [5] , road transport has consistently contributed the largest percentage of emissions in the transport sector. The detailed representation of the GHG emissions by mode of transport is shown in Table 2-1

Table 2-1: GHG Emissions by mode of transport (Gg CO2e)

	2003		2010		2019		2020	
	Passenger	Freight	Passenger	Freight	Passenger	Freight	Passenger	Freight
Road	518	682	1671	994	3416	1349	3700	1424
Aviation	136	15	212	24	331	37	350	38
Rail	11,6	3,8	11,3	3,7	2,2	0,7	4,5	1,5
Water	0,2	0,2	0,3	0,3	0,8	0,8	0,9	0,9

2.1.1.3 Emission trends in the waste sector

The waste sector is the second-largest emitter of greenhouse gases (GHG), in Kampala, the capital of Uganda, with 28% of the city's overall emissions coming from solid waste management at landfill sites, waste incineration, and wastewater.[6]

The city produces approximately 2,300 tonnes of solid waste daily, resulting in a yearly total of 803,000 tonnes. It is projected that this figure will double by the year 2030. The waste is predominantly organic and biodegradable, accounting for about 75% of the total amount. Additionally, 15% of the waste is made up of recyclable materials like plastics, paper, metal, and glass. [7]

In the waste sector, methane (CH_4) accounts for the largest share of GHG emissions in the waste sector, accounting for about 95% of the gases and 80% in terms of CO2 equivalents. CH_4 emissions from solid waste emissions rose over fivefold from 5.7Gg in 2005 to 32Gg 2015, an average of 31.9% annual increment. Emissions from domestic and industrial wastewater discharge are estimated to have increased at an average of 2.6% and 4.5% per annum which is lower than the rate of urbanisation.

[5] GIZ Uganda (2021), Data Collection for Mitigation Potential Analysis and Scenario Development in Uganda's Transport Sector

[6] Oates, Lucy, Ross Gillard, Peter Kasaija, Andrew Sudmant, and Andy Gouldson (2019), Supporting decent livelihoods through sustainable service provision: Lessons on solid waste management from Kampala, Uganda, A Coalition for Urban Transitions, London and Washington, DC. http://newclimateeconomy.net/content/cities-working-papers

[7] Ministry of Water and Environment (MWE) (2022), Uganda Updated Nationally Determined Contributions

2.1.1.4 Institutional arrangements

According to Uganda's National Greenhouse Gas Inventory report for the years 2005 to 2015, the national Greenhouse Gas Inventory and capacity building is coordinated by the Climate Change Department under the Ministry of Water and Environment. The responsibility of data collection and analysis for the transport and waste sectors, is vested in different government Ministry, Department and Agencies (MDAs).

For the waste sector, the key institutions that are responsible for collecting and analysing data to estimate emissions in the sector include Kampala City Council Authority (KCCA), National Water and Sewerage Corporation (NWSC), Uganda Bureau of Statistics (UBOS). The Ministry of Local Government (MOLG) and Municipal authorities also provide data on waste and disposal in urban centres other than Kampala. The Ministry of Agriculture provides data on manure / waste generation and management in the agricultural sector. The Ministry of Health and UBOS provide data on clinical waste generation and disposal (mainly incineration mechanism).

The key data providers for the computation of emissions in the energy sector, which encompasses the transport sector include the Ministry of Energy and Mineral Development (MEMD), Ministry of Finance and Economic Development (MFED), Kampala Capital City Authority (KCCA), Ministry of Works and Transport (MOWT), Uganda Railway Corporation (URC), among others.

2.1.2 International best practice for adaptation and mitigation actions

2.1.2.1 Introduction

Climate change mitigation refers to activities or interventions which are aimed at reducing or preventing emission of greenhouse gases.[8] Mitigation is achieved either by reducing the sources of these gases or establishing a cleaner mobility system or by enhancing the storage of these gases. In short, mitigation is a human intervention that reduces the sources of GHG emissions and/or enhances the sinks.

Climate change adaptation refers to adjustments in processes, practices and structures in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects with an aim to moderate potential damages they can cause or to benefit from opportunities associated with climate change.[9] According to the Intergovernmental Panel on Climate Change (IPCC), adaptation is a critical component of the long-term global response to climate change to protect people, livelihoods and ecosystems.[10]

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[8] UNEP, Climate Action: Mitigation, https://www.unep.org/explore-topics/climate-action/what-we-do/mitigation#:~:text=Climate%20Change%20Mitigation%20refers%20to,management%20practices%20or%20consumer%20behavior .

[9] United Nations Climate Change, Introduction: Adaptation and Mitigation, https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction

[10] United Nations Climate Change, Adaptation and resilience: Introduction,

The known impacts of climate change include extremely high temperatures, drought, intense rainfall leading to flooding, more intense winds and/or storms, sea level rise, loss of vegetation, reduction in biodiversity due to encroachment from non-indigenous species, among others. Uganda and Kenya, in particular, have suffered from the invasion of non-indigenous water hyacinth which has extended down to the Sudan and Egypt along River Nile. These can seriously impact transport infrastructure, operations, and mobility for road, rail, shipping, and aviation.[11]

Successful adaptation not only depends on governments but also on the active and sustained engagement of stakeholders, including local communities, national, regional, multilateral and international organisations, public and private sectors, civil society and other relevant actors, as well as an effective management of knowledge. Parties to the UNFCCC and its Paris Agreement recognise that adaptation is a global challenge faced by all with local, subnational, national, regional and international dimensions.

The IPCC-recommended policy cycle for undertaking adaptation measures is illustrated in Figure 2-1.

https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction

[11] Intergovernmental Panel on Climate Change (IPCC) (2022), "Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change", https://www.ipcc.ch/report/sixth-assessment-report-working-group-3.

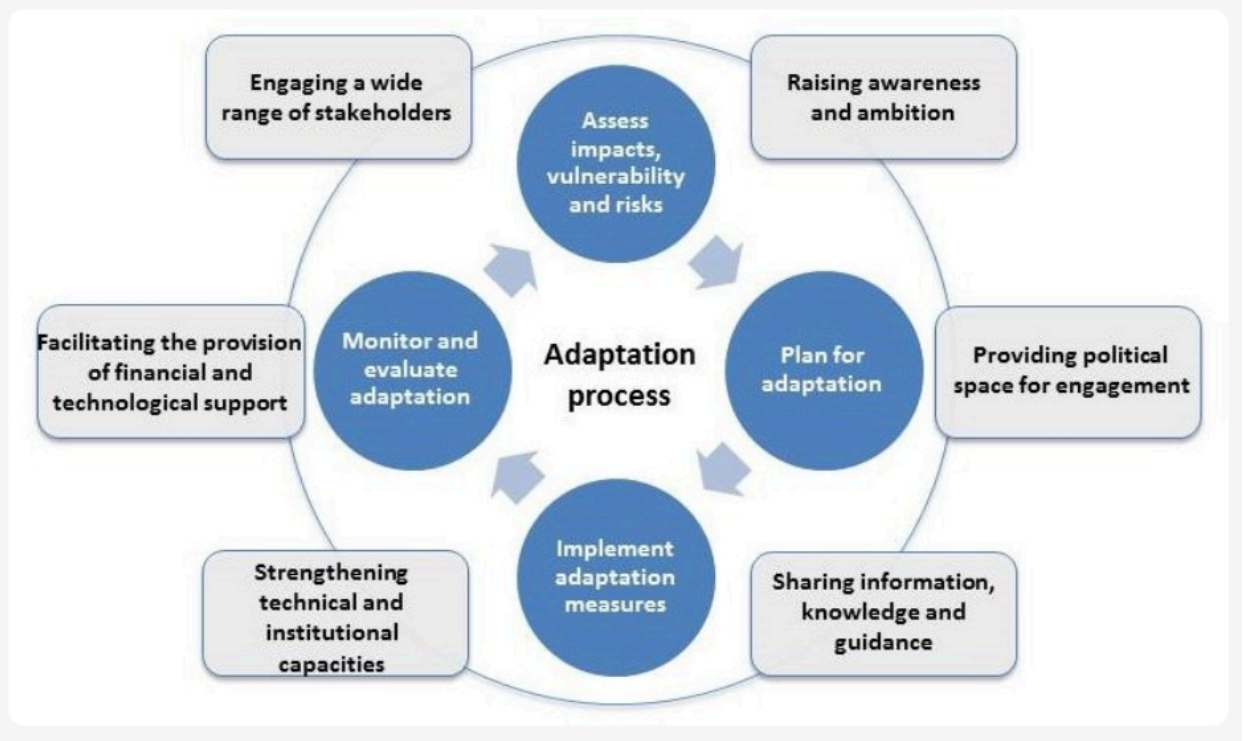

Figure 2-1: Recommended policy cycle for implementing adaptation measures (Source: IPCC)E

2.1.2.2 Transport Sector

In 2019, global transport CO_2 emissions, including international aviation and shipping, accounted for 22% of total global CO_2 emissions.[12]

According to the World Resources Institute, improving mass transit is one of the few strategies which can achieve climate change mitigation and adaptation simultaneously. This is because resilient low-carbon mass transit addresses both the challenge of the significant share of CO_2 emissions attributed to road transportation and reduces the vulnerability of transport infrastructure which is extremely vulnerable to climate change impacts like storms and extreme heat.[13]

Increased public transportation also has the added benefits of relieving traffic congestion, reducing accidents and fatalities, and improving air quality which contribute achieving the Sustainable Development Goals 3, 9, and 11.

Mitigation actions in the transport sector

The Avoid-Shift-Improve (ASI) framework is a holistic approach which is applied universally to mitigate

[12] SLOCAT (2023), Global Status Report on Transport, Climate and Sustainability – 3rd edition, www.tcc-gsr.com.

[13] I. Suarez (2020), "5 Strategies that Achieve Climate Mitigation and Adaptation Simultaneously", World Resources Institute, 10 February, https://www.wri.org/insights/5-strategies-achieve-climate-mitigation-and-adaptation-simultaneously

the impacts of transportation activity on the environment by reducing the CO_2 emissions from the sector by:

- Avoiding unnecessary motorised transport demand through smarter and denser spatial planning, development of efficient logistic systems, and improved communications technology;
- Shifting transport to lower carbon-intensive modes such as cycling, walking, and public transport; and
- Improving the GHG efficiency through improved vehicle design, energy efficiency, clean energy sources for transportation.[14]

The ASI approach follows an implicit hierarchy, with appropriate and context-sensitive 'Avoid' measures intended to be implemented first, followed by 'Shift' measures and finally by 'Improve' measures. This prioritisation can help reduce environmental impact, improve access to socio-economic opportunities, increase logistics efficiency, reduce congestion, improve air quality and increase road safety.[15]

A balanced and inter-modal application of Avoid, Shift, and Improve measures is capable of yielding an estimated reduction in transport emissions of 2.39 GtCO2-equivalent by 2030 and 5.74 GtCO2-equivalent by 2050.[16]

Specific measures which can be implemented in the transport sector to support mitigation of climate change are as follows:

1. Promote and encourage walking and cycling: These non-motorised modes of transportation are the only modes which have zero lifecycle emissions and are therefore the key to decarbonising the transport sector. Walking and cycling generate the least noise and air pollution, and they accrue significant health benefits. Already in Africa, more than a billion people walk or cycle every day to reach work, their homes, school, and other essential services, spending a daily average of 56 minutes. This is 12.1 points higher than the global average of 43.9 Minutes.[17] However, despite the significant modal share of these modes of

[14] Asian Development Bank (2010), Reducing Carbon Emissions from Transport Projects, https://www.oecd.org/derec/adb/47170274.pdf

[15] SLOCAT (n.d), Avoid-Shift-Improve Refocusing, https://slocat.net/asi/

[16] IPCC (2018), Global Warming of 1.5°C: An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA; Gota, Sudhir & Huizenga, Cornie & Peet, Karl & Medimorec, Nikola & Bakker, Stefan (2019), Decarbonising transport to achieve Paris Agreement targets, Energy Efficiency, 12, 10.1007/s12053-018-9671-3.

[17] United Nations Environment Programme and United Nations Human Settlements Programme (2022). Walking and Cycling in Africa: Evidence and Good Practice to Inspire Action. Nairobi.

transport, road and traffic conditions in most cities make it not only uncomfortable, but deadly for people to walk or cycle.

2. Apply the Transit-Oriented Development (TOD) approach in urban planning: Transportation is a critical part of spatial planning. TOD is a spatial planning concept which aims at maximising the density of residential, business and leisure space within walking distance of public transport. TOD is aimed at increasing the value proposition of public transport over private transportation, increase the ridership of public transport, and encourage more sustainable modes of travel like walking and cycling.[18]

The TOD Standard developed by the Institute for Transportation Development (ITDP) is a unique assessment tool, and a condensed policy brief which lays out the core principles of inclusive TOD, based on ITDP's Principles of Urban Development for Transport in Urban Life, and identifies the key concrete objectives that are essential to implementing these principles in urban development.[19]

According to the IPCC Transport Working Group, cities can reduce their transport-related fuel consumption by around 25% through combinations of more compact land use and the provision of less car-dependent transport infrastructure such as protected pedestrian and cycling pathways to support much greater localised active travel.[20]

3. Electric mobility: Battery electric vehicles (BEVs) have lower lifecycle greenhouse gas emissions than internal combustion engine vehicles (ICEVs) when BEVs are charged with low-carbon electricity. Globally, electromobility is being rapidly implemented in micro mobility (e-autorickshaws, e-scooters, e-bikes), in transit systems, especially buses, and, to a lesser degree, in the electrification of personal vehicles. BEVs could also have the added benefit of supporting grid operations.[21]

4. The use of alternative fuels as such as natural gas, biofuels, ammonia, and synthetic fuels as a strategy to decarbonise the predominant Internal Combustion Engines. Apart from

https://wedocs.unep.org/20.500.11822/

[18] R. Cervero (2004), Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects, TRB's Transit Cooperative Research Program (TCRP) Report 102, https://nap.nationalacademies.org/catalog/23360/transit-oriented-development-in-the-united-states-experiences-challenges-and-prospects

[19] ITDP(2017), TOD Standard (Version 3.0), https://www.itdp.org/library/standards-and-guides/tod3-0/about-the-tod-standard/

[20] Intergovernmental Panel on Climate Change (IPCC) (2022), "Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change", https://www.ipcc.ch/report/sixth-assessment-report-working-group-3

[21] Intergovernmental Panel on Climate Change (IPCC) (2022), "Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change", https://www.ipcc.ch/report/sixth-assessment-report-working-group-3.

electrification, several other fuel technologies have been developed to reduce the current fossil fuel dependence of the transport sectors. Natural gas in vehicles can be used as compressed natural gas (CNG) which is suitable for commercial vehicles and light-to-medium-duty vehicles or Liquefied Natural Gas (LNG) which is more suitable to replace diesel in heavy-duty vehicles. CNG vehicles have been widely deployed in some regions, particularly in Asian-Pacific countries. China which currently has the highest number of about 6 million CNG vehicles. [22]

Natural gas-based vehicles have certain advantages over conventional fuel-powered ICE vehicles, including lower emissions of criteria air pollutants, no soot or particulate, low carbon to hydrogen ratio, moderate noise, a wide range of flammability limits, and high-octane numbers. According to the International Energy Agency, biofuels provide a relevant mitigation opportunity to decarbonise the transport sector, especially in developing countries, in the short- and mid-term (up to 2050). The technology is available at affordable costs, has a relatively high technology readiness level, and can be implemented and/or scaled at a relatively high speed compared to other technologies. Another important advantage of biofuels is that they can be converted into energy carriers compatible with existing technologies, including current powertrains and fuel infrastructure.[23]

5. Shared mobility: Shared mobility an internationally growing and one of the largest sectors of the shared economy today. This includes services such as bike sharing, car sharing, and on-demand mobility. Shared mobility provides an opportunity to increase the utilisation rate of light-duty vehicles, which translates into greater fuel efficiency. However, the shared mobility can also have negative impacts for decarbonising transport by diverting users from more sustainable travel options such as mass transit.

6. Digital and home-based services: Digitalisation facilitates activities such as working from home, and online shopping which directly translate in reduced demand for transport. Digitalisation also supports the implementation of smart mobility, which can be used to influence transport demand and efficiency.

Adaptation actions in the transport sector

Adaptation of the transport sector to the impacts of climate change is largely reliant on incorporating resilience in the planning, design, and construction of transport infrastructure.

In the context of urban transportation, a resilient transport system is characterised by; 1) the capacity to anticipate its climate risks, 2) the capacity to adapt what is changeable and 3) the capacity to withstand inevitable impacts. Together, these abilities enable the system to continue to deliver its service

[22] Intergovernmental Panel on Climate Change (IPCC) (2022), "Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change", https://www.ipcc.ch/report/sixth-assessment-report-working-group-3.

[23] Intergovernmental Panel on Climate Change (IPCC) (2022), "Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change", https://www.ipcc.ch/report/sixth-assessment-report-working-group-3.

objectives.

The "access-based" perspective on transport resilience also provides a holistic view of both the coming hazards and the available adaptation options. For example, the shift from mobility-based access to digitally based access (work from home, flexible work hours, satellite offices) can provide a vital risk mitigation tool. A "triple access transport planning" approach – which incorporates physical mobility, spatial proximity and digital connectivity can be applied through the FUTURES Toolkit. FUTURES stands for 'Future Uncertainty Toolkit for Understanding and Responding to an Evolving Society', and it is an approach that was designed to support decision making at the strategic planning stage. [24]

In order to maximise resilience in the transport sector, it is recommended that adaptation activities are integrated into the planning in other sectors, especially with urban planning.[25] Specific measures which can be employed in relation to the transport sector include:

1. Implementing nature-based adaptation solutions such as restoration of natural water bodies, and building natural drainage systems which act as natural carbon sinks and improve air quality, but also help to prevent flooding of land transport systems. An example of successful implementation of nature-based solutions in Sub-Saharan Africa is in Mozambique, along the River Chiveve which runs through the city.
2. Designing and implementing early warning systems for road transport risk
3. Climate scenario modelling

2.1.2.3 Waste Sector

According to data from 2020 by Climate Watch of the World Resources Institute[26], the global emissions from the waste sector amounted to 3.2% of the global emissions of which about 2% was constituted by Methane (CH_4) emissions from landfills, and the majority of the majority of the rest from Methane and Nitrous Oxide (N_2O)) emissions from anaerobic treatment of wastewater with organic matter, human and animal waste residues. As such any efforts to reduce emissions in the Waste sector are targeting these primary sources of emissions in the sector.

Adaptation and mitigation actions in the waste sector are crucial for managing environmental impacts and reducing greenhouse gas emissions. Comprehensive and effective climate action planning that includes Mitigation and Adaptation measures for the Waste Sector has been recommended

[24] Lyons, G. (2021). Discovering 'the sweet spot'. https://www.tapforuncertainty.eu/author/lyons/ ; Mott MacDonald (2023). Vision-led strategic planning for an uncertain world", https://www.mottmac.com/article/59966/futures-vision-led-planning-for-an-uncertain-world

[25] D. Black, N. Pyatt (2020), Adapting Urban Transport to Climate Change Module 5f, Islamic Development Bank, https://www.isdb.org/sites/default/files/media/documents/2021-10/Adapting%20Urban%20Transport%20to%20Climate%20Change.pdf

[26] World Resources Institute (2020), "Global GHG emissions by Sector", World Resources Institute, https://ourworldindata.org/ghg-emissions-by-sector

internationally to be founded on the following principles, namely; evidence-based understanding of climate change impacts resulting from the Waste Sector and how these impacts can be mitigated; information on the interaction between the effects of climate change on the development of Waste Management infrastructure; alignment of Waste Sector policies with overall Climate Change Policies; climate change funding opportunities that are relevant to a country's waste sector; and good practices in waste management that result in reduced GHG emissions or increase the sector's resilience[27].

To establish effective mitigation and adaptation actions or measures the following would be required:

- an assessment to establish the GHG reduction potential for various components of the waste sector for effective mitigation actions; and
- an assessment of climate impact risk and vulnerabilities in the sector so as to design effective adaptation measures to improve resilience.

Some international best practices for adaptation and mitigation in the waste sector are listed below[28].

Mitigation Actions for the Waste Sector:

Some best practice measures to reduce or prevent greenhouse gas emissions in the waste sector include:

1. Circular Economy: Promote a circular economy approach, encouraging the reuse, repair, and remanufacture of products and materials to increase the lifespan of products and reduce the rate of generation of waste and minimize environmental impacts, thus addressing adaptation as well. A successful implementation of a circular economy approach would require educating the public about the environmental impact of waste and promote responsible waste disposal practice including improvement in waste sorting and segregation systems to enhance recycling and reduce contamination in waste streams that leads to anoxic conditions leading to production of Methane.

The main strategies of circular economy are presented in Figure 2-2 below, with 7 resource efficiency methods with decreasing cost-effectiveness and increasing environmental impact:

a. Waste Removal or Reduction: Promote waste reduction at the source through education and awareness campaign that led to removal of a need for a given resource or reducing its production for example by reducing demand.

b. Reduce: Aims at reducing the overall consumption of resources, while maximizing their

[27] European Union, 2021 "Guideline on climate change mainstreaming into waste sector policies", UNDP and EU. https://www.undp.org/sites/g/files/zskgke326/files/migration/md/UNDP_EU4Climate_RWA_Guideline.on.climate.change_final_ENG.p

[28] European Union, 2021 "Guideline on climate change mainstreaming into waste sector policies", UNDP and EU. https://www.undp.org/sites/g/files/zskgke326/files/migration/md/UNDP_EU4Climate_RWA_Guideline.on.climate.change_final_ENG.pdf

utility. Reducing involves minimizing waste and using resources more efficiently. This could be achieved by reusing products, optimizing industrial processes to decrease raw material usage and implementing designs fostering disassembly and recycling.

c. Re-source: Encouraging substitution of a product with one that meets the remaining need or demand with a material with a lowest ecological impact.

d. Reuse: Having waste of one process being used as a resource or input in another process.

e. Recycling Programs: Implementation and expansion of recycling programs to reduce the amount of waste sent to landfills or incinerators that would eventually generate methane or Carbon dioxide emissions.

f. Recover: Approach taken where neither reuse nor recycling can be achieved, but it is possible to recover some part of the waste e.g. converting embedded energy into heat by burning solid waste.

g. Return: Bringing products, materials or components back into the system after their initial use. It could involve activities such as recycling, treatment or refurbishing old products, remanufacturing or repurposing products to extend their lifespan and keep them in circulation within the economy, rather than being disposed off as waste.

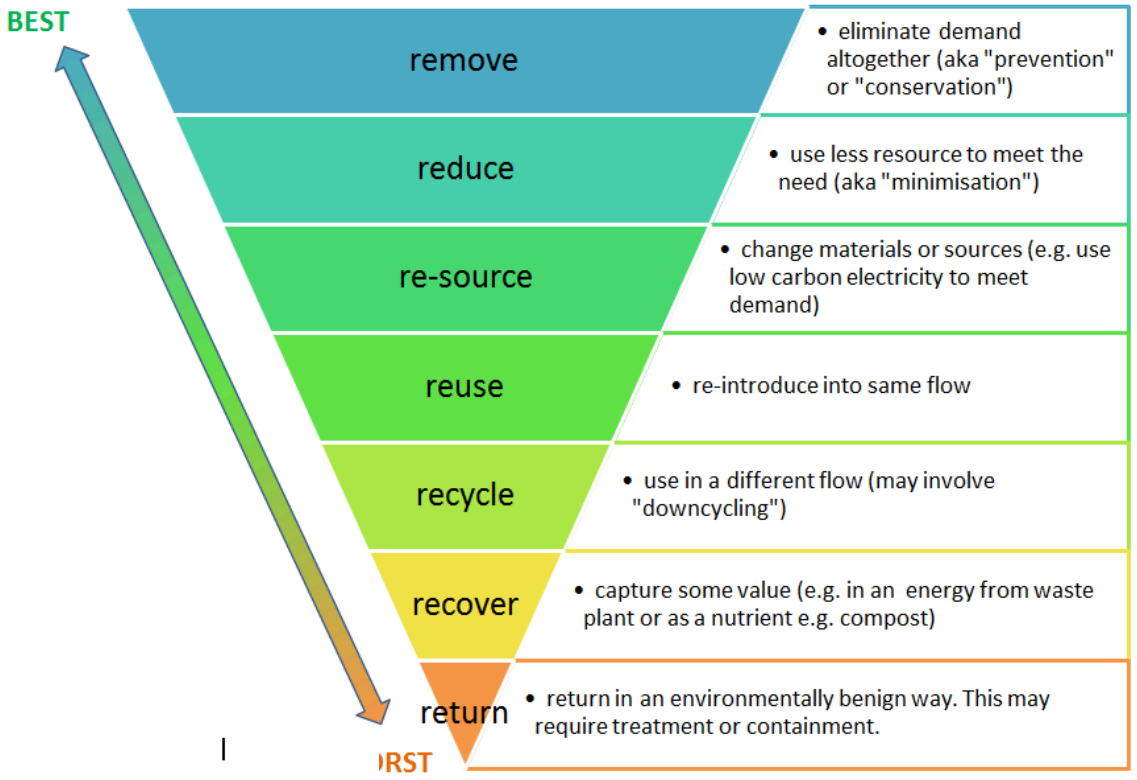

Figure 2-2: Resource efficiency hierarchy [29]

2. Methane Capture Initiatives: Implement systems to capture and utilize methane emissions from landfills and wastewater treatment plants and either flare it or converting it into

[29] https://www.sustainsuccess.co.uk/the-resource-efficiency-hierarchy

renewable energy –both thermal and electrical energy for captive use or for export to other users.

3. Waste-to-Energy: Explore waste-to-energy technologies that can convert waste into energy, reducing greenhouse gas emissions and dependence on fossil fuels by their displacement with energy generated from the waste to energy plants.

4. Eco-friendly Waste Management: Invest in modern and environmentally friendly waste management technologies such as gasification treatment and anaerobic digestion and with methane recovery and energy production or aerobic treatment of waste. For gasification pre-treated waste feedstock (RDF) is treated in a reduced oxygen environment, thereby limiting the process to partial combustion and partial oxidation. The process produces a synthesis gas (syngas) which can be cleaned up and used as a replacement for natural gas or combusted and used to feed a steam turbine producing electricity and/or heat.

5. Extended Producer Responsibility (EPR): Establish EPR programs that hold manufacturers responsible for the entire life cycle of their products, encouraging sustainable design and waste reduction.

6. Waste Data Management: Use data and analytics to optimize waste collection and disposal routes, reducing energy consumption and emissions.

7. Policy and Regulation: Enforce policies and regulations that encourage responsible waste management and reduce emissions. E.g., green Procurement policies to encourage government agencies and organizations to purchase products with reduced packaging and environmentally friendly materials. Collaborate with the private sector to develop and invest in innovative waste management technologies and practices.

8. Waste Audits: Conduct waste audits to identify opportunities for waste reduction and resource recovery and follow through to implementation.

Adaptation Measures for the Waste Sector, to the impacts of Climate Change

Identification of effective adaptation actions would require an analysis of the potential climate impacts (e.g. temperature changes, increased or reduced precipitation) and the degree of vulnerability of the waste management sector and devise measures to increase resilience to such impacts. Some best practice adaptation measures for the waste sector include:

1. Climate-Resilient Infrastructure: Build and maintain waste management infrastructure (landfills, wastewater treatment plants) that can withstand extreme weather events and sea-level rise. This requires hydraulic modelling e.g. to establish the anticipated extent of flooding for rainfall events of different return periods.

2. Waste Diversion: Implement strategies to divert waste away from landfills, such as recycling and composting, to reduce landfill exposure to climate-related risks. (More on Circular economy under mitigation measures for the waste sector.)

3. Flood Prevention: Establish proper drainage systems and flood protection measures around waste facilities e.g. landfill. This requires hydraulic modelling e.g. to establish the anticipated extent of flooding for rainfall events of different return periods. These measures would also prevent contamination of water bodies during floods e.g. contamination with leachate.

4. Waste Site Location: Avoid locating waste facilities in flood-prone or vulnerable areas to minimize climate-related risks. This would also be informed by a flood risk assessment with

hydraulic modelling of the areas where such sites are to be located.

5. Contingency Plans: Develop contingency plans for waste management during extreme weather events to ensure continued service provision e.g. evacuation of waste during floods.

2.1.3 iMRV system in Uganda

The Integrated Monitoring, Reporting, and Verification (iMRV) system is a tool used to manage and track the progress of the climate actions as stipulated in the updated Nationally Determined Contributions (NDC). This system is designed to improve the management and reporting of greenhouse gas inventories, streamline the assessment of climate action impacts, and support the consistent monitoring of progress towards international commitments under the Paris Agreement. By integrating various data parameters from the waste and transport sector, among other sectors, the iMRV system ensures comprehensive analysis and fosters transparency in Uganda's climate initiatives. The MWE-CCD as the custodian of the iMRV system, is mandated to ensure its alignment with national and international standards for climate action reporting.

For the waste sector, the iMRV system currently allows for the input of activity data that allows for the estimation of tier 1 greenhouse gas emissions from the four key IPCC sub-sectors under waste. These include: emissions from solid waste disposal, from biological treatment of solid waste; incineration and open burning of waste; and wastewater treatment and discharge. The iMRV system is being updated currently to allow the use of nationally determined emission factors, instead of the IPCC defaults, to allow progression from tier 1 to tier 2 approach to calculation of emissions.

For the transport sector's iMRV system enables the input of activity data for estimating greenhouse gas emissions for the sub-sectors such as road transportation, including passenger cars, light-duty trucks, heavy-duty trucks, buses, and motorcycles, as well as railway transportation. The planned update to incorporate nationally determined emission factors for a more accurate tier 2 approach in emissions calculation, transitioning from the default tier 1 IPCC methodology, will significantly support tracking and managing the transport sector's contribution to the nation's greenhouse gas emissions.

2.2 Stakeholder Mapping and Engagement

The mitigation and adaptation actions stipulated in the Updated NDC for Uganda, for the transport and waste sectors, were reviewed and the relevant Stakeholders for implementation of these actions were identified. The identified stakeholders were consulted to ascertain the degree of implementation of the various mitigation and adaptation actions stipulated in the transport and waste sectors of the updated NDC.

2.2.1 Stakeholder Identification

Stakeholder mapping for the transport and waste sectors in Uganda was done to include government agencies, local authorities, technical experts, private sector entities, research institutions, and development partners. The preliminary list of stakeholders identified is shown in Table 2.

Categorisation of the stakeholders identified was then done based on their level of influence, interest, and role in the project. The stakeholders identified were categorised into; primary/key stakeholders:

those directly affected by the project outcomes, such as government agencies, local authorities, and communities, and secondary stakeholders: those indirectly affected, such as research institutions, international organizations, and donors.

Table 2-2: List of stakeholders identified

No.	Stakeholder Category	Institution name and Department	Primary sector
1	Government entity	National Water and Sewerage Corporation (NSWC)	Waste
2	Government entity	National Environment Management Authority (NEMA)	Both
3	Government entity	Ministry of Energy and Mineral Development (MEMD)	Both
4	Government entity	Ministry of Water and Environment (MWE)	Both
5	Government entity	Kampala Capital City Authority (KCCA)	Both
6	Government entity	Ministry of Local Government (MOLG)	Both
7	Private Sector	Uganda Sugar Manufacturer's Association	Waste
9	Government entity	Ministry of Works and Transport (MoWT)	Transport
10	Government entity	Uganda National Roads Authority (UNRA)	Transport
11	Government entity	Uganda Railways Corporation (URC)	Transport
12	Academia	Makerere University Center for Climate Change Research and Innovations (MUCCRI)	Both
13	Private Sector	Climate Action Network Uganda (CAN-U)	Both
14	Development Partner	East African Development Bank (EADB)	Both
15	Development Partner	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Both
16	Government Entity	Ministry of Lands, Housing and Urban Development	Transport
17	Government Entity	National Planning Authority (NPA)	Both
18	Private Sector	The NDC Partnership – United Nations Climate Change (UNFCC)	Both
19	Development Partner	African Development Bank (AFDB)	Both
20	Government Entity	Parliamentary Forum on Climate Change	Both
21	Development Partner	United Nations Development Programme (UNDP)	Both
22	Government Entity	Ministry of Finance, Planning and Economic Development	Both
23	Development Partner	Institute for Transport Policy Development	Transport
24	Government Entity	Municipal and Town Councils (Secondary Cities)	Transport
No.	**Stakeholder Category**	**Institution name and Department**	**Primary sector**
25	Government Entity	Ministry of Gender Labour and Social Development (MGLSD)	Both
26	Private Sector	Kiira Motors Corporation	Transport
27	Government Entity	Uganda Revenue Authority (URA)	Transport
28	Private Sector	KaCyber Technologies	Transport
29	Private Sector	Karaa Africa	Transport
30	Private Sector	BodaWerk	Transport

31	Private Sector	Zembo	Transport
32	Development Partner	Islamic Development Bank, Uganda Regional Office	Transport
33	Government Entity	Ministry of Science, Technology & Innovation	Transport
34	Private Sector	Safari Share	Transport
35	Government Entity	Insurance Regulatory Authority	
36	Government Entity	Civil Aviation Authority (CAA)	

It is important to note that stakeholder engagement is a continuously evolving process because the roles of different stakeholders change throughout the project life cycle. As a result of this new stakeholders may be identified during the course of the project implementation.

2.2.2 Stakeholder Interviews

The Consultant, through the assistance of CCD, established contact with all the stakeholders identified. The stakeholder entities assigned their most suited staff as primary contacts for this project, after which interviews were scheduled. The interviews were primarily conducted in-person, except for circumstances where stakeholders specifically requested to meet virtually or a physical meeting was not deemed necessary. The interviews were guided by survey questionnaires for both the transport and waste sectors.

The interviews were primarily aimed at understanding the climate change mitigation and adaptation actions which were being implemented by the entities that had been identified as either primary or secondary stakeholders in either the transport or waste sectors. This information was obtained through discussion of any previous, ongoing and planned projects which are related to climate change mitigation and adaptation in the transport and waste sectors.

A detailed discussion of the findings of consultation process with different stakeholders in provided in the Stakeholder Engagement Report.

2.3 Secondary Data Collection

After establishing rapport with the different stakeholders through the initial interviews, the Consultant carried out follow-up engagements with stakeholders who had alluded to owning and collecting primary data on the key performance indicators of the climate change adaptation and mitigation actions in either the transport or waste sectors. Other relevant data to be obtained from stakeholders includes details of the previous, ongoing or planned projects for example project objectives, project funders, expected commissioning dates, etc.

The process of obtaining the secondary datasets from stakeholders is still ongoing.

The data collected through the literature review and stakeholder consultations can be categorised into four main categories:

i. Climate change mitigation and adaptation actions stipulated for the transport and waste sectors in Uganda's updated NDC.

ii. Climate change mitigation and adaptation measures which have been implemented or are currently being implemented by stakeholders in the transport and waste sectors,

iii. Climate change mitigation and adaptation measures which are planned for future implementation in the transport and waste sectors, and

iv. International best practice with respect to the climate change mitigation and adaptation actions for the transport sector and the waste sector.

The first three categories of the data were presented in the database, and the fourth category is presented in the section 2.1.2 of this report above.

3 Database Development

3.1 Introduction

Following the methods described in the previous sections of this report, the databases for the NDC mitigation and adaptation actions in the transport and waste sectors were developed in Microsoft Excel environment.

The databases were designed to capture all relevant data in alignment with the mitigation and adaptation actions for the transport and waste sectors in Uganda's updated NDC, the indicators and their respective targets. In order to ensure seamless integration into the existing monitoring, reporting and verification system (iMRV), care was taken to align the structure with the requirements of the iMRV system. This alignment aimed to facilitate an easy data transfer process to the iMRV system at the end of this project.

The draft databases are provided as annexures to this report, in the Microsoft Excel Workbook format.

3.2 Database structure

The database is presented in two separate excel workbooks, one each for the Transport and Waste Sectors. The selected data entry sections in these files not only meet the needs of the iMRV system but also support comprehensive reporting and monitoring of various adaptation and mitigation measures. Below are the data entry sections, each with their respective descriptions:

i. NDC action relevant to transport and waste sector: this section details the actions proposed or taken to reduce greenhouse gas emissions as part of Uganda's updated NDC.

ii. Description of NDC action strategy: offers a detailed explanation of the strategy behind the action.

iii. Sub-sector from which the NDC action was obtained: Identifies the specific sub-sector (e.g., solid waste, wastewater, transport (mobile energy consumption) related to the action.

iv. Status: denotes the current implementation status of the action, such as planned, or implemented.

v. Key performance indicators as provided in Uganda's updated NDC: specifies the metrics used to

measure the effectiveness and progress of the actions.

vi. Type/ category of performance indicator: clarifies the nature of the performance indicator, whether activity indicator, GHG effects indicator, intermediate effects indictor.

vii. Measurement units of the key performance indicator: Indicates the unit of measurement for the performance indicators.

viii. BAU Scenario: Stands for 'Business As Usual' and projects targets and outcomes if no additional actions are taken, with columns for 2025, 2030, and 2050.

ix. NDC Scenario: Projects the expected targets and outcomes in line with the actions stipulated by the NDC for 2025, 2030, and 2050.

x. Performance to-date: tracks the current performance against the indicators.

xi. Projects currently being implemented under the action: Lists ongoing projects under the various actions.

xii. Project objectives: outlines the aims and goals of each project under the specified action.

xiii. Project start and end date: provides the timeline for the related projects under the actions.

xiv. Project location/spatial scope: describes the geographic area where the project is being implemented.

xv. Project cost: details the financial investment for each project or action.

xvi. Source of funding: identifies where the funding for the projects or actions comes from.

xvii. Implementing agency: specifies which government or non-government entity is responsible for carrying out the project or action.

xviii. Executing agency: states which organization is in charge of the day-to-day execution of the project or action.

xix. Lifetime: estimates the expected operational lifespan of the project or action.

xx. Expected commissioning date: indicates when the project or action is scheduled to be operational.

xxi. Umbrella policy/regulatory instrument: links the action or project to the overarching policy or regulation that governs or supports it.

3.3 Data entry and maintenance

1. Data entry

Data entries have been made using the developed structure of the database. Project staff familiar with the relevance of the data have undertaken these entries. Regular checks have been done to immediately detect and correct any errors or inconsistencies during the entry process.

2. Updating procedures

The database was systematically updated at regular intervals, primarily driven by the insightful feedback received from stakeholders. These structured updates were instrumental in refining the collected data, ensuring not only its accuracy but also its comprehensive representation of the scenarios as reported by stakeholders.

3. Quality assurance

To guarantee the reliability and accuracy of the data, a specific quality assurance process was implemented. During the duration of the project, the database will undergo periodic reviews to ensure its accuracy and relevance. The Consultant will perform reviews to confirm that the data aligns with the stipulated requirements and mirrors the actual situations accurately. Discrepancies, if identified, were promptly addressed.

4. Backup

To safeguard against potential data loss scenarios, regular edits of the database have been stored on a designated Google Drive for the project. This method ensures easy access and recovery while benefiting from Google Drive's inherent security measures. In addition to the cloud backup, data security protocols have been implemented to authorize only project staff to access the drive.

4 References