Technical Engagement with the Climate Change Department on Uganda's Methane Emissions Roadmap

Date: October 2, 2026
Venue: Ministry of Water and Environment Office
Meeting Chair: Mr. Semambo Muhammad, representing Commissioner Bob Natif



Purpose: To discuss civil society's review of the draft National Action Plan for Short-Lived Climate Pollutants and Methane Emissions Roadmap, clarify outstanding technical issues and identify opportunities for collaboration on methane emissions abatement.

1. Background and Purpose

The meeting was convened to facilitate technical engagement between civil society organizations and the Climate Change Department (CCD) on Uganda's efforts to address

methane emissions and other short-lived climate pollutants, particularly in the context of the country's emerging oil and gas sector.

Civil society organizations had previously reviewed the draft National Action Plan for Short-Lived Climate Pollutants and Methane Emissions Roadmap and submitted comments on its content, structure, technical clarity and implementation arrangements. The engagement sought to obtain clarification from the technical team responsible for the document, understand the government's approach to incorporating oil and gas emissions into national climate reporting frameworks, and identify areas for further collaboration.

The discussion also explored opportunities to strengthen the capacity of government institutions and Civil Society to understand emissions data, engage constructively with government and contribute to effective monitoring and reporting of methane emissions.

2. Opening Remarks and Government's Climate Reporting Framework

The meeting was chaired by Mr. Semambo Muhammad, who provided an overview of the mandate of the Climate Change Department. He explained that the department provides national policy direction, conducts research and guides the development of frameworks for climate change mitigation, adaptation and greenhouse gas reporting. Sector ministries and agencies are responsible for developing and implementing sector-specific climate actions, while CCD coordinates the overall national framework.



He highlighted the role of the national greenhouse gas (GHG) inventory in informing Uganda's climate commitments, including its Nationally Determined Contributions (NDCs), national communications and transparency reporting to the United Nations Framework Convention on Climate Change (UNFCCC).

The Chair emphasized that the national inventory is based on activity data from the relevant sectors and provides the basis for assessing emissions, establishing baselines and tracking progress towards national mitigation targets. Consequently, reliable data collection and reporting are essential for ensuring that national climate commitments are evidence-based and measurable.

2.1 Incorporating oil and gas into the NDC

A key clarification concerned the treatment of Uganda's oil and gas sector in its NDCs. The Chair explained that Uganda's current NDC includes oil and gas-related mitigation measures, but does not yet establish a production-related greenhouse gas emissions target for the sector. This distinction arises because commercial oil production has not commenced.

Existing fuel-related emissions recorded in the national inventory primarily reflect the consumption of imported fuels within Uganda, rather than emissions from domestic oil and gas production. The Chair noted that once production begins, the relevant activity data will need to be collected and incorporated into a sectoral inventory, which will subsequently inform the national GHG inventory and future emissions projections and mitigation targets.

He also highlighted measures already being considered in relation to the sector, including reducing gas flaring, undertaking environmental offsets where appropriate and strengthening the capacity of relevant institutions and industry actors to collect and report emissions data. The Chair stressed that NDCs are evolving national plans that must be informed by research, available data and national development priorities. Not every intervention can be included in an NDC, and the selection of priorities must take account of the implementation period and the feasibility of monitoring progress.

2.2 Relationship between methane and short-lived climate pollutants

The meeting further clarified the relationship between greenhouse gases and short-lived climate pollutants. Methane falls within both categories, meaning that its emissions are accounted for within the GHG framework while measures to reduce methane can also contribute to broader air-quality and short-lived climate pollutant objectives. The Chair explained that the national reporting framework follows internationally established inventory categories to avoid double counting. The methane roadmap therefore complements the NDC and other national climate frameworks by identifying measures to address methane and other relevant pollutants.

3. Civil Society Review of the Draft Roadmap



Mr. Paul Twebaze presented the principal observations arising from the civil society review. He explained that the review was motivated by the need to understand how Uganda's emerging oil and gas sector was being addressed within existing climate policies and mitigation plans. He noted that the review was intended to support constructive engagement with government and strengthen the quality of the roadmap as a national policy and implementation document. The principal observations were as follows.

3.1 Alignment of baselines, targets and planning periods

Civil society noted inconsistencies in the roadmap's references to 2035 and 2040. While some mitigation measures and projections referred to 2040, other sections presented targets and cost-of-inaction scenarios for 2035.

In response, Mr. Isaac explained that the two planning periods reflected different modelling exercises. The 2040 scenario was aligned with Uganda's Vision 2040, while the 2035 scenario was developed to align with the implementation period of NDC 3.0.

Civil society welcomed this clarification but observed that the explanation was not sufficiently explicit in the document. The Chair agreed that the relevant sections should be reviewed to ensure the modelling approach and the relationship between the two planning horizons were clearly explained.

Regarding the use of 2019 as the baseline year, the technical team explained that this was based on the latest national greenhouse gas inventory available in the country's submitted reporting at the time the roadmap was developed. The baseline was also intended to maintain consistency with the inventory and NDC modelling processes.

The Chair added that the ongoing transition to the Enhanced Transparency Framework and the preparation of the Biennial Transparency Report would contribute to updating the national inventory and informing future baselines.

3.2 Clarifying the document's purpose and terminology

Civil society observed that the document was variously described as an inventory, report, action plan and roadmap, creating uncertainty about its primary purpose. The Chair explained that the document was designed as a combined national action plan for short-lived climate pollutants and a methane emissions roadmap. The inventory and other technical assessments provide the evidence base for the proposed interventions.

The technical team indicated that the combined format reflected the requirements of the supporting initiative and the intention to present the underlying assessment alongside the proposed actions.

Participants agreed that the document's introduction and terminology should be clarified to explain the relationship between the assessment, inventory and roadmap, without necessarily separating them into different documents.

3.3 Strengthening the objectives and justification

Civil society observed that some of the stated objectives appeared to describe tasks undertaken by the consultant rather than the intended outcomes of the government's roadmap. The review recommended that the objectives be reframed to communicate what the document is intended to achieve, including providing guidance on the management of methane and other short-lived climate pollutants, strengthening institutional coordination and supporting implementation of mitigation measures.

Civil society also recommended strengthening the justification by clearly explaining the problems the roadmap seeks to address, including gaps in baseline data, limited emissions measurement and reporting capacity, institutional coordination challenges and constraints in mobilizing resources for implementation.

The CCD technical team acknowledged the observations and indicated that the objectives and justification would be reviewed to improve their clarity and effectiveness.

3.4 Data gaps and geographical coverage

Civil society noted that some sections relied heavily on information from Kampala to illustrate conditions across the country, particularly in relation to waste and associated health impacts. While recognizing the limitations of available data, participants recommended drawing on additional information from other urban areas and relevant government institutions, including the Ministry of Health, where such data are available.



The technical team explained that data availability remains a significant challenge across several sectors. Although national statistical exercises provide some information, detailed studies on the nature and characteristics of emissions sources are often concentrated in Kampala. The discussion highlighted the need for further research and improved geographical coverage to strengthen the evidence base for national mitigation planning.

3.5 Institutional coordination and allocation of responsibilities

Civil society expressed concern that the roadmap did not sufficiently clarify the roles of institutions responsible for implementing the proposed interventions. The review specifically highlighted the absence of clear references to the Ministry of Agriculture, despite agriculture being an important source of methane emissions, and the Ministry of Health, given the roadmap's discussion of air quality and health impacts.

The CCD representatives explained that the inventory and implementation framework are structured according to established international reporting categories and that not every institution can be listed individually in the overall coordination framework. However, responsible institutions are identified against specific interventions where applicable.

The technical team acknowledged the importance of reviewing the institutional arrangements to ensure that key institutions are appropriately reflected and that their responsibilities are clear.

3.6 Financing, monitoring and evaluation

Civil society emphasized that the roadmap needed clearer arrangements for financing, monitoring and evaluating implementation. The review noted that a plan without an

identifiable financing approach, implementation responsibilities and monitoring framework risks remaining a policy document without effective implementation.

The CCD technical team confirmed that costing and resource mobilization were intended to be addressed as a subsequent step. The team acknowledged that a costed plan would be important for resource mobilization and effective implementation.

3.7 Mainstreaming gender and just transition considerations

Civil society highlighted the need to consider the social implications of proposed mitigation measures, particularly those relating to the transition from charcoal and other traditional energy sources to cleaner and renewable alternatives. Participants recommended that the roadmap give greater attention to gender considerations, the implications of proposed technologies for affected communities and the distribution of costs and benefits associated with the energy transition. This would help ensure that proposed interventions are responsive to the circumstances of different groups and support an equitable transition.

4. Discussion on Oil and Gas Emissions Data

A substantial part of the meeting focused on the apparent absence of oil and gas production emissions in the roadmap, where the figures were presented as zero. Civil society questioned how these figures related to emissions estimates and projections contained in environmental impact assessments and information associated with ongoing oil and gas development activities.



The Chair clarified that the zero figures referred to the absence of actual domestic oil production activity data for inclusion in the production component of the national inventory. He distinguished between emissions estimates and projections developed for environmental assessment purposes and actual activity data used to calculate emissions in the national inventory.

He explained that, when commercial production commences, the responsible institutions and industry operators will need to collect activity data using agreed parameters and incorporate these into a sectoral oil and gas inventory. This information would then feed into the national inventory managed by CCD.

The discussion underscored the importance of establishing reliable arrangements for data collection, validation and reporting before production begins. Participants also emphasized

that capacity development should extend beyond the lead government ministry to include relevant regulatory institutions and private sector operators.

4.1 Understanding the oil and gas value chain



Mr. Paul Bagabo proposed that stakeholders undertake further work to understand the oil and gas value chain, from extraction and processing to transportation and refining, in order to identify potential sources of methane emissions and determine the data required at each stage. He observed that understanding the technologies and processes involved would help stakeholders identify emission points, establish appropriate data collection methods and clarify which institutions are responsible for monitoring and reporting the relevant information.

Participants further highlighted the importance of understanding methane capture at production facilities and strengthening capacity in methane management, safety and reporting. The discussion also recognized that some activities and emissions may occur at different stages or locations along the value chain, requiring clarity on the scope of reporting and the responsibilities of the institutions involved.

5. Capacity Development and Collaboration

The meeting identified capacity development as an important area for collaboration between CCD, civil society and other relevant stakeholders. Mr. Paul Bagabo explained that NRGI was considering a needs assessment to identify capacity gaps and develop a concept note for targeted training. Since NRGI does not provide the technical training directly, the proposed approach would involve identifying specialist organizations to deliver training while NRGI and its partners convene relevant stakeholders.

The discussion identified two related priorities:

- Strengthening technical capacity: Building the capacity of relevant institutions and stakeholders to understand methane emissions, emissions sources, data requirements, measurement and reporting processes.
- Improving stakeholder engagement: Equipping civil society organizations with sufficient technical knowledge to engage constructively with government, communicate accurately and contribute meaningfully to policy development and implementation.

The CCD representatives explained that capacity development activities were already being undertaken through sectoral technical working groups and initiatives supporting enhanced

transparency and greenhouse gas reporting. These activities target relevant government institutions and, in some cases, private sector and civil society participants.

The department noted that capacity development for the oil and gas sector would need to be aligned with the sector's readiness and the availability of appropriate data for practical training. Participants also discussed the potential value of using illustrative or sample data to strengthen stakeholders' understanding of emissions reporting.

NRGI expressed interest in exploring opportunities to work with the Ministry of Water and Environment and other relevant institutions to develop targeted capacity-building activities for civil society.

The discussion reinforced the importance of building a common understanding of the national reporting framework before undertaking wider awareness-raising activities. Participants observed that stronger technical capacity would enable civil society to engage more effectively and contribute to informed public discussion.

6. Key Outcomes

The meeting generated the following key outcomes:

1. *Clarification of the national reporting framework:* CCD explained how the national GHG inventory informs Uganda's NDCs and other climate reporting processes, including the distinction between imported fuel consumption and emissions from domestic oil and gas production.
2. *Clarification of the roadmap's planning periods:* The technical team explained that the 2035 and 2040 scenarios serve different purposes, with 2035 aligned to NDC 3.0 and 2040 aligned to Vision 2040. The document needs to communicate this distinction more clearly.
3. *Recognition of civil society's technical input*: CCD welcomed the comments on the draft roadmap and confirmed that the document was still under development, making the feedback timely.
4. *Need to improve the document's clarity:* The technical team acknowledged the need to review the document's terminology, objectives, justification, modelling explanations and institutional arrangements.
5. *Recognition of data and reporting gaps*: Participants highlighted the importance of preparing for oil and gas production by strengthening sectoral data collection, validation and reporting arrangements.
6. *Capacity development identified as a priority:* Participants recognized the need to strengthen the technical capacity of relevant government institutions, industry actors and civil society organizations.
7. *Potential for continued collaboration:* NRGI expressed interest in working with the Ministry of Water and Environment and relevant partners to explore targeted capacity development and improved stakeholder engagement.

7. Agreed and Proposed Follow-up Actions

Follow-up action	Responsible party	Status
Review the roadmap to clarify the rationale for the 2035 and 2040 planning horizons and their relationship to NDC 3.0 and Vision 2040.	CCD technical team	Identified for review
Clarify the use of 2019 as the baseline year and explain the relationship between the roadmap, emissions assessment and inventory.	CCD technical team	Identified for review
Review the title, introduction, objectives and justification to improve the document's clarity and communicate its intended outcomes.	CCD technical team	Identified for review
Review the institutional coordination and implementation framework, including the roles of relevant sector institutions.	CCD technical team	Identified for review
Strengthen the treatment of data gaps, geographical coverage, financing, monitoring and evaluation, and relevant social and gender considerations.	CCD technical team	Raised for consideration
Develop a clearer understanding of the oil and gas value chain, potential emissions sources and the data required at different stages of production and transportation.	NRGI, civil society and relevant government and industry stakeholders	Proposed for further engagement
Explore targeted capacity development for civil society on methane emissions, activity data, emissions measurement and reporting.	NRGI, CCD and relevant technical partners	Proposed for further engagement
Explore opportunities to engage specialist organizations to support technical training and stakeholder convening.	NRGI and relevant partners	Under consideration
Continue dialogue between civil society and CCD on the roadmap and related national climate reporting processes.	CCD and participating civil society organizations	Ongoing engagement

8. Conclusion

The meeting provided an important opportunity for civil society organisations to obtain technical clarification on Uganda's national greenhouse gas reporting framework and the treatment of methane emissions from the oil and gas sector. It also enabled participants to present detailed feedback on the draft National Action Plan for Short-Lived Climate Pollutants and Methane Emissions Roadmap.

A central message from the discussion was that effective methane emissions abatement depends on reliable data, clear institutional responsibilities, appropriate technical capacity and alignment between national climate plans and sectoral implementation arrangements. The meeting also highlighted the importance of communicating technical information clearly so that government institutions, civil society and other stakeholders can understand their respective roles and contribute effectively.

CCD welcomed the civil society observations and indicated that the draft document was still under development. The engagement therefore created an opportunity to address outstanding issues before finalization.

Going forward, continued technical dialogue and targeted capacity development will be important for strengthening civil society participation, improving understanding of the oil and gas emissions data requirements and supporting the effective implementation of Uganda's climate commitments.

ANNEX

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MINISTRY OF WATER AND ENVIRONMENT
REPUBLIC OF UGANDA

NATIONAL ACTION PLAN TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS AND ROADMAP FOR METHANE MITIGATION IN UGANDA

July 2025



CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

SEI Stockholm Environment Institute

ECI ENVIRONMENTAL COMPLIANCE INSTITUTE

Foreword

On behalf of the Government of Uganda, I present the National Action Plan to Reduce Short-Lived Climate Pollutants (SLCPs) and Roadmap for Methane Mitigation in Uganda. The Government of Uganda recognises the substantial impact that Short-Lived Climate Pollutants, including methane, black carbon and hydrofluorocarbons (HFCs) are causing to climate change, and to the quality of the air that the citizens of Uganda breathe. Uganda is a proud member of the Climate and Clean Air Coalition and is committed to reducing SLCP emissions for the benefit of Ugandan citizens and for the planet.

This Plan has come out of a strong collaborative effort between several Government Ministries, and other relevant stakeholders, and is a key milestone for Uganda in combating SLCPs. This Plan fulfils a key commitment in Uganda's 2022 Nationally Determined Contribution to develop a national inventory of SLCPs and air pollutants. It meets that commitment by identifying major sources of SLCPs, including methane, and identifying and evaluating specific actions that can reduce them.

We acknowledge the 4 priority mitigation measures that could reduce methane, black carbon, and HFCs by 14%, 22%, and 54% by 2035 and we urge all stakeholders, across sectors, to work together to implement these actions and reap the multitude of benefits.

We would like to thank the organisations and partners that funded and supported the development of this Plan, including the Climate and Clean Air Coalition (CCAC), the Stockholm Environment Institute (SEI), and the Environmental Compliance Institute (ECI).

[Signed by…]

Acknowledgements

This Plan was led by the Ministry of Water and Environment in Uganda with funding from the Climate and Clean Air Coalition and implemented by the Environmental Compliance Institute (ECI) and the Stockholm Environment Institute (SEI).

Coordination of the Plan development from the Ministry of Water and Environment was led by Irene Chekwoti. A technical working group provided insights and contributions to the plan from the outset, during drafting, and during revisions. The technical working group comprised Adam Sebbit, Anna Winnie Adoch, Atukunda Rachael, Charles Mutemo, Dan Kiguli, Denis Maholo, Derick Senyonga, Domisiano Owor, Freddie Kabango, Imelda Kanzomba, Jennifer Kutesakwe, Juliet Atino, Kibono Jamali, Myers Murumu, Nabaho Emmanuel, Nabisubi Grace, Oketch Lazarus, Richard Mugambwa.

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Executive Summary

Air pollution and climate change are two of the biggest environmental issues of the 21st century. According to the Global Burden of Disease Study, air pollution is the second greatest risk to human health globally and in 2021 accounted for 8.1 million premature deaths (IHME, 2025). The detrimental impact of air pollution is not limited to human health. Air pollutants, in particular ozone, pose an increasing risk to crop productivity and food security while actions to reduce air pollution can contribute to several sustainable development goals. At the same time as air pollutants impact public health, crop yields, and sustainable development, atmospheric emissions are warming the atmosphere.

Air pollution is a growing concern in Uganda. The average concentration of the most health-damaging air pollutant, fine particulate matter ($PM_{2.5}$) is estimated to be 34 $\mu g/m^3$. Such a level means that Ugandans are, on average, breathing air that contains air pollution levels that are almost 7 times higher than the World Health Organisation recommended level for protection of human health (IHME, 2024). This makes air pollution the second largest risk associated with premature mortality in Uganda, accounting for almost 29 thousand deaths. Uganda makes a small contribution to global greenhouse gas emissions. In 2022, Uganda contributed less than 1% of total greenhouse gas emissions (excluding emissions from land use change) (Crippa et al. 2023). In contrast, Uganda is one of the countries most vulnerable to the impacts of climate change (University of Notre-Dame, 2024).

The issues of air pollution and climate change are closely linked, meaning that there is a large opportunity to identify and implement actions that simultaneously deal with both issues. Firstly, there is substantial overlap in the major sources of pollutants that cause climate change and that impact human health as air pollutants (Figure 0.1). For example, agriculture is the largest source of methane, nitrous oxide, nitrogen oxides, and ammonia, while the residential sector is the largest source of black carbon, particulate matter (PM_{10} and $PM_{2.5}$), organic carbon, carbon monoxide, nitrogen oxides, the second largest source of nitrous oxide, and ammonia, and contributes to methane emissions. Action that targets emission reductions in these sectors can therefore reduce multiple pollutant emissions that contribute to both issues. Secondly, Short-Lived Climate Pollutants (SLCPs) are a subset of pollutants that contribute directly to both climate change and air pollution. These substances include black carbon, ground-level ozone, methane, and hydrofluorocarbons (HFCs). Targeting SLCPs is an opportunity to address climate change and air quality simultaneously, especially in reducing the rate of near-term warming. Methane is particularly important to mitigate climate change and achieve internationally agreed temperature limits. Methane has made the second-largest contribution to climate change to date behind carbon dioxide, contributing 0.5 °C global temperature increases since preindustrial times. Tackling methane is essential to reduce the rate of warming in the near-term while strong, fast reductions in carbon dioxide are needed to limit long-term warming.

The Government of Uganda has made substantial efforts over the past five years to increase its capacity to understand and mitigate SLCPs. Uganda joined the Climate and Clean Air Coalition in 2021 and the 2022 Nationally Determined Contribution (NDC) provides a clear mandate for the development of an SLCP Plan. The 2022 NDC stated the country's ambition to develop a national inventory of SLCPs and air pollutants including black carbon, methane, and hydrofluorocarbons. This Plan meets that commitment by identifying major sources of SLCPs,

including methane, in Uganda and identifying and evaluating specific actions that can reduce them. This plan can therefore contribute to achieving Uganda's climate change goals while at the same time improving the health of Ugandans by reducing exposure to air pollution across the country.

Major source of SLCPs including methane in Uganda

This Plan quantifies the air pollutant and greenhouse gas emissions in Uganda. In 2019, total methane emissions are estimated to be 1.0 million tonnes with the largest sources being enteric fermentation of livestock (71%), followed by residential energy demand (11%) and waste (9%) (Figure 0.1). Total black carbon emissions in 2019 are estimated to be 25 thousand tonnes with the residential sector making the greatest contribution of 38% of total black carbon emissions. The second largest source of black carbon is industrial energy use, followed by charcoal production. HFC-134a was the only HFC included in this analysis as data was not available for other HFCs. Total HFC-134a in 2019 was 74 tonnes, which in terms of the 100-year global warming potential, is equivalent to 91 thousand tonnes of CO_2.

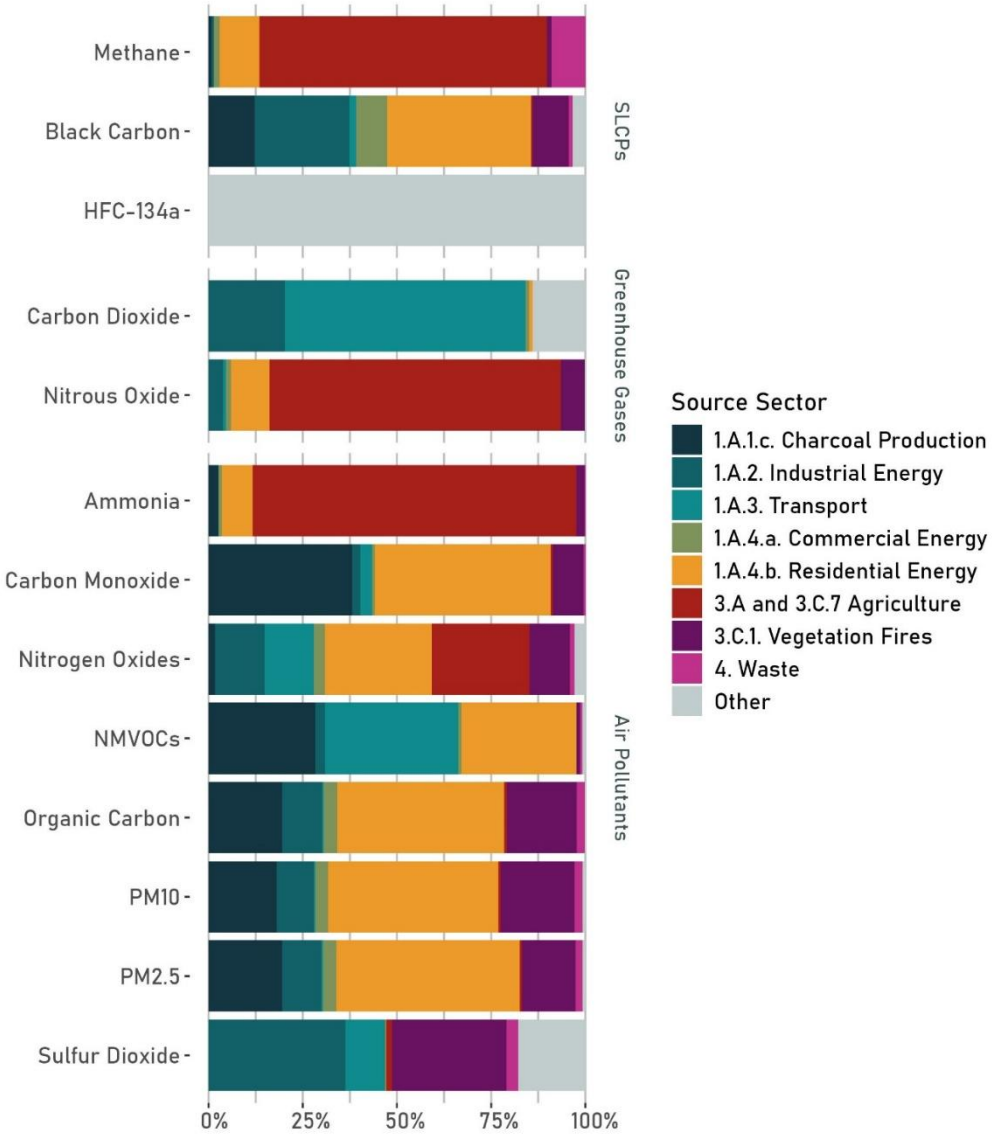


Figure 0.1. There is a substantial overlap in sources of SLCPs, greenhouse gasses, and air pollutants in Uganda.

Without Action, SLCP and methane emissions will continue to increase

If no action is taken to reduce SLCPs (i.e. the baseline scenario), then emissions of methane and black carbon are projected to increase by 69% and 135% respectively by 2035, i.e. by 2035 emissions of black carbon could be more than double compared to 2019. Taking this further to 2040, emissions of methane are projected to increase by 95% for methane while black carbon is projected to increase by 216%, or a 3-fold increase.

Four mitigation actions could curb rises in SLCP and methane emissions and improve health

Despite the projected increase in emission in the baseline scenario, substantial emission reductions could be achieved in Uganda if SLCP action is taken. This SLCP Plan identifies 19 key mitigation measures which, if fully implemented, could reduce methane and black carbon by 17% and 33% by 2035 (Figure 0.2). Of these 19 measures, 4 have been identified as priority actions with the largest mitigation potential. These measures are:

1. 100% of households have access to either clean fuels or efficient stoves by 2040
2. 70% of solid waste is collected and managed in landfills with methane capture by 2040.
3. Increase livestock productivity and reduce methane emission intensity
4. HFCs phased out in line with the Kigali Amendment

These 4 priority measures could reduce emissions of methane, black carbon, and HFCs by 14%, 22%, and 54% respectively by 2035. By 2040, methane reductions could reach 17% and HFC reductions reach 74%.

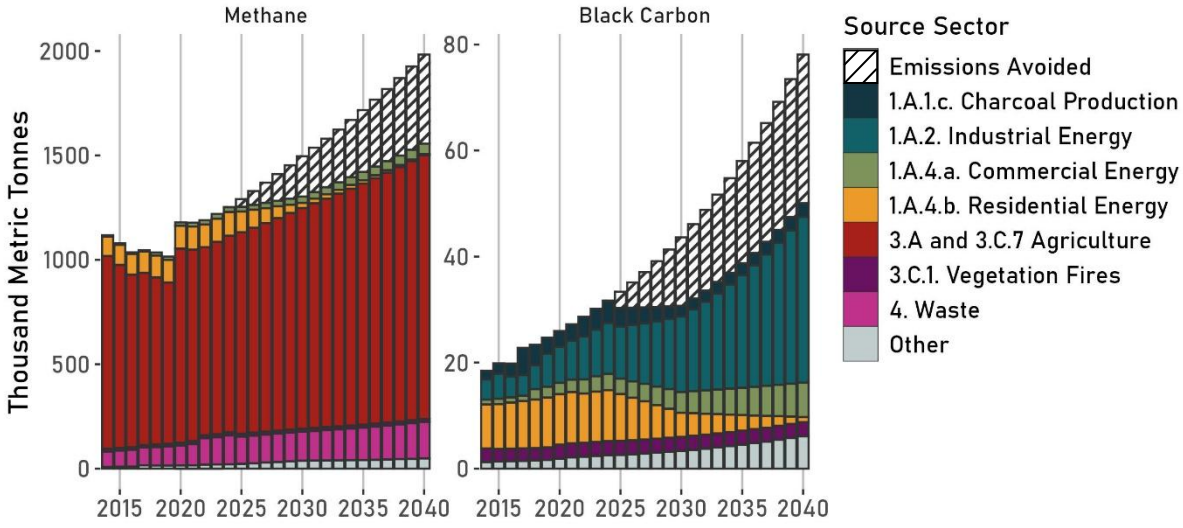


Figure 0.2. Reduction in methane (left) and black carbon (right) emissions in Uganda if all 19 SLCP measures are implemented. Emissions are shown for years from 2019 to 2040 under the mitigation scenario. Colour denotes emission source sectors and dashed bars represent the emission reduction potential of the mitigation scenario compared to the baseline scenario, i.e. the emissions avoided. For each pollutant, only the largest four emission sources are shown, the remaining sources are summed under 'all others.'

Implementing SLCP actions can also bring about co-benefits through reducing other pollutants

Implementing SLCP measures can contribute to national commitments to reduce carbon dioxide (CO_2). Under the SLCP mitigation scenario where all measures are implemented, emissions of CO_2 are reduced by 9% by 2040. Emissions of other ozone precursors such as nitrogen oxides, organic carbon, carbon monoxide, non-methane volatile organic carbons, and ammonia can be reduced by between 10-71% by 2040. If the 4 priority measures are implemented in isolation, then there could be a trade-off in pollutants as increased use of LPG for cooking leads to increased fossil CO_2 emissions. SLCP actions therefore need to be implemented alongside actions to reduce CO_2.

Implementing SLCP actions could save lives in Uganda

The full implementation of Uganda's SLCP Plan could reduce population-weighted $PM_{2.5}$ concentrations by 5.6 µg m^3 in 2040 compared to the baseline scenario and avoid 1,175 premature deaths in 2040 (Table 0.1). If only the 4 priority measures are implemented in isolation, 842 premature deaths could be avoided by 2040.

This SLCP Plan identifies key sources of SLCPs, greenhouse gases and air pollutants. It identifies nationally relevant mitigation measures that could reduce emissions and evaluates the co-benefits of these actions. The Plan also highlights potential barriers to achieving these actions and provides implementation pathways for each mitigation measure, as well as recommendations on how the success of these measures can be monitored and evaluated.

Table 0.1. Summary of $PM_{2.5}$ concentrations and health impacts in the baseline and SLCP Plan mitigation scenario when all 19 measures are implemented.

Metric	Units	Scenario	2019	2030	2035	2040
Population-weighted $PM_{2.5}$	µg/m^3	Baseline	19.6	20.7	22.8	25.6
		Mitigation	19.6	18.9	19.3	19.9
Premature deaths	People	Baseline	3,949	6,267	8,115	10,472
		Mitigation	3,949	5,976	7,469	9,298

Table of Contents

Foreword 1

Acknowledgements 2

Executive Summary 3

Table of Contents 7

1. Introduction 8

1.1. Air Pollution 8

1.2. Climate Change 9

1.3. The link between air pollution and climate change 9

1.4. Air pollution in Uganda 12

1.5. Climate Change in Uganda 13

1.6. Aims and objectives of the SLCP Plan and Methane Roadmap 14

1.7. Institutional framework and the role of a SLCP Plan in Uganda 15

2. Short-Lived Climate Pollutant emission sources in Uganda 20

2.1. Objectives of the SLCP Mitigation Assessment 20

2.2. Estimation of SLCP emissions in Uganda 20

Summary of methods 20

Methane emissions 21

Black carbon emissions 25

Hydrofluorocarbon (HFC) emissions 28

2.3. Co-emitted pollutants 28

2.4. Comparison of SLCP emissions inventory with national government data 30

3. Short-Lived Climate Pollutants mitigation measures in Uganda 35

3.1. Baseline Scenario 41

3.2. Mitigation Scenario 42

3.3. Priority mitigation measures 46

3.4. Health impacts of SLCP actions 49

4. Implementation pathways for Short-Lived Climate Pollutant measures 53

5. Monitoring implementation of Short-Lived Climate Pollutants measures 79

5.1. Indicators of Success 80

5.2. Indicators of Implementation 81

6. References 84

1. Introduction

Air pollution and climate change are two of the biggest environmental issues of the 21st Century. In 2021, air pollution was associated with 8.1 million premature deaths globally (IHME, 2025) while anthropogenic climate change has warmed the atmosphere, ocean and land, increased the frequency of climate extremes and exposed millions of people to food insecurity, reduced water security, and mortality from heat stress, floods, droughts, and storms (IPCC, 2023).

1.1. Air Pollution

According to the Global Burden of Disease Study, air pollution is the second greatest risk to human health globally, second only to high systolic blood pressure (IHME, 2025). Air pollution-associated mortality is primarily due to cardiovascular and chronic pulmonary diseases (IHME, 2025), but air pollution is also linked to other non-fatal health effects, such as difficulties during pregnancy, asthma, and emergency room visits (Anenberg et al., 2018; Malley et al., 2017). Fine particulate matter ($PM_{2.5}$) and ozone (O_3) are the air pollutants which are responsible for the greatest impact on human health. Fine particulate matter is made up of different components and can either be directly emitted into the atmosphere (primary $PM_{2.5}$), or form through chemical reactions in the atmosphere (secondary $PM_{2.5}$). Components of primary $PM_{2.5}$ include black carbon (BC) and organic carbon (OC), while secondary $PM_{2.5}$ can be formed through emissions of nitrogen oxides (NO_x), sulphur dioxide (SO_2), ammonia (NH_3), or volatile organic compounds (VOCs). Like secondary $PM_{2.5}$, ozone is not directly emitted, but forms in the atmosphere from ozone precursors. Ozone precursors include nitrogen oxides, volatile organic compounds, methane, and carbon monoxide. In the presence of sunlight, these substances undergo chemical reactions in the atmosphere to form ozone.

The detrimental impact of air pollution is not limited to human health. Air pollutants, in particular ozone, pose an increasing risk to crop productivity and food security. Globally, yield losses due to ozone are estimated to range between 2.6 and 7.2% with substantial regional variation (Tai et al., 2021). These yield losses have implications for land use, with lower yields requiring more cultivated land to meet the demand for crops (Chuwah et al., 2015).

The impacts of air pollution on health and crop yields also have socio-economic ramifications. Air pollution impedes progress toward the Sustainable Development Goals (SDGs). For example, the use of biomass for household cooking is a major source of air pollution and hinders progress towards SDG 7 (Affordable and Clean Energy) and SDG 3 (Good Health and Well-Being). Furthermore, women are disproportionately exposed to indoor air pollution meaning, until the issue is tackled, we are unable to achieve SDG 5 (Gender Equality). Impacts on human health, crop yields, and sustainable development more broadly all have associated economic costs (e.g. through healthcare costs, loss in labour productivity, reduced revenue from tourism, etc.). The economic costs associated with health impacts alone were estimated to be $8.1 trillion, or 6.1% of global GDP in 2019 (World Bank, 2022). This is likely to be a substantial underestimate given the multitude of impacts associated with air pollution.

1.2. Climate Change

At the same time as air pollutants impact public health, crop yields, and sustainable development, atmospheric emissions are warming the atmosphere. Since pre-industrial times, global average temperatures have risen by 1.1°C (Intergovernmental Panel on Climate Change (IPCC), 2023), while the Paris Agreement sets the goal of limiting the increase in global average temperatures to "well below 2°C", and ideally to 1.5°C (United Nations, 2015). Current climate change commitments are estimated to lead to a warming of more than 3°C by 2100, so more action is needed to meet the Paris Agreement targets (Rogelj et al., 2016). Scientific studies have concluded that the level of greenhouse gas emission mitigation achieved through current Nationally Determined Contributions (NDCs) needs to be increased if the Paris Agreement long-term temperature goals are to be achieved. Estimates of future warming based on emission pledges in current NDCs, assuming they are fully implemented, vary between 2.3 and 3.7°C of warming by 2100 (Gütschow et al., 2018; Jeffery et al., 2018; Robiou Du Pont et al., 2017).

The impacts of climate change are widespread. For example, health impacts include heat-related illness, injury and mortality from extreme weather events, malnutrition, and food-borne diseases, as well as impacts on healthcare facilities and systems (IPCC, 2023). It is estimated that in 2021, there were 1.9 million premature deaths due to non-optimal temperatures alone while approximately 3.5 billion people are highly vulnerable to climate change (IPCC, 2023; IHME, 2024). Extreme weather events attributable to climate change are responsible for significant adverse societal costs. It has been estimated that these events equate to USD 143 billion per year, the majority of which is associated with the loss of human life (Newman & Noy, 2023).

1.3. The link between air pollution and climate change

Air pollution and climate change are closely linked through shared emission sources. Key emitting sources such as residential cooking, industry, transport, electricity generation, agriculture, and waste are both sources of air pollutants and both long-lived greenhouse gases and SLCPs. SLCPs are substances that contribute to both climate change and the adverse effects of air pollution. These substances include black carbon, ground-level ozone, hydrofluorocarbons, and methane (Figure 1.1). SLCPs are also termed short-lived climate forcers (SLCFs) by the Intergovernmental Panel on Climate Change (IPCC), as stated in their Sixth Assessment Report highlighting the critical role of SLCFs in climate change (IPCC, 2023). The report emphasizes the need for integrated policies to manage their emissions alongside long-lived greenhouse gases, which is accompanied by a methodology report on SLCF inventory to be released in 2027 (IPCC, 2024). Air pollution and climate change are linked because the interaction between air pollution and climate change can amplify the risks to the environment and health (Sillmann et al., 2021; Tai et al., 2021).

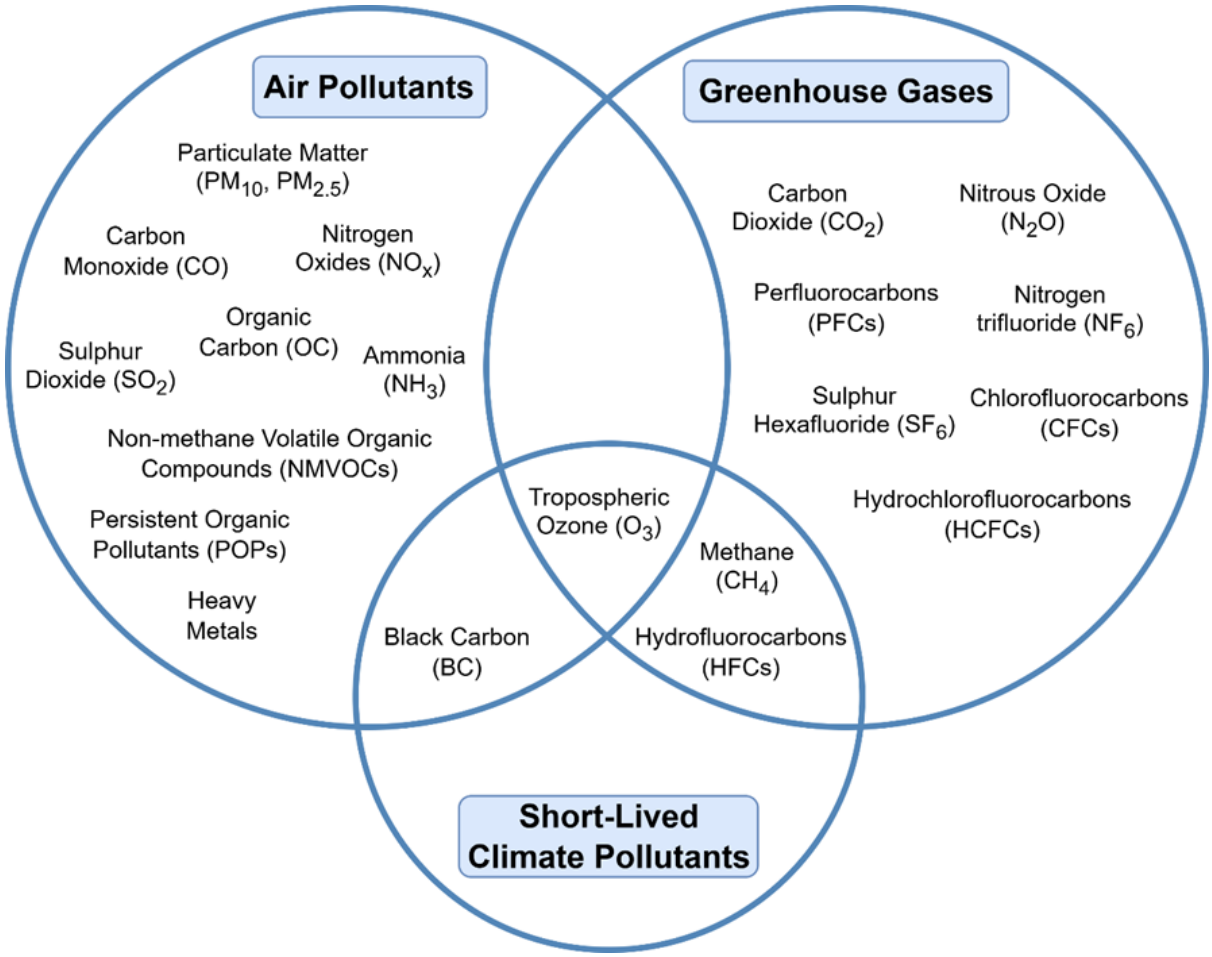


Figure 1.1. Summary of pollutants that are classified as air pollutants, short-lived climate pollutants, and greenhouse gases.

The strong linkages between air pollution and climate change provide a critical opportunity to simultaneously act on both issues and achieve multiple benefits. Due to the overlap in emission sources, common solutions which tackle both issues can be implemented. For example, the transport sector is a major source of both air pollutants (black carbon, nitrogen oxides, fine particulate matter, etc.) and climate pollutant gases (CO_2 and, to a lesser extent, methane). Introducing policy measures which mitigate emissions from this source can reduce the health impact associated with high air pollutant concentrations and contribute to climate targets through reductions in CO_2 emissions. At times, there can also be trade-offs between air pollutants and greenhouse gases. For example, introducing electric vehicles as a measure to reduce emissions from transport reduces the CO_2 emissions from vehicle fuel combustion, but may incur an increase in emissions from electricity generation if fossil fuels are consumed. Considering air and climate pollutants in conjunction allows these opportunities for co-benefits, and risks of trade-offs, to be properly evaluated.

Targeting SLCPs is an opportunity to address climate change and air quality simultaneously, especially in reducing the rate of near-term warming. The SLCPs include methane, tropospheric ozone, and hydrofluorocarbons (HFCs), which are all also greenhouse gases, and black carbon,

a component of $PM_{2.5}$, which warms the atmosphere, but is not a greenhouse gas. They have been grouped due to their i) relatively short atmospheric lifetime (days to a couple of decades), ii) warming effect on the atmosphere, and iii) effects on human health and agricultural crop yields as air pollutants (except HFCs).

Although CO_2 makes the largest contribution to climate change, and reducing CO_2 emissions is essential to achieving long-term climate stability, reducing CO_2 emissions has a limited impact on near-term warming. CO_2 has a lifetime in the atmosphere of approximately 100 years, meaning that it can take over 100 years for the CO_2 that has already been emitted to be removed from the atmosphere. Methane has made the second greatest contribution to global temperature increases but spends ~15 years in the atmosphere before it is removed. Therefore, the mitigating effect of reducing methane emissions occurs more rapidly compared to a reduction in CO_2 emissions. The United Nations Environment Programme (UNEP) and Climate and Clean Air Coalition (CCAC) Global Methane Assessment, published in 2021, showed that globally, a ~45% reduction in global methane emissions in 2030 was necessary to be consistent with achieving 1.5°C. Doing so would avoid 0.3°C of global temperature increases, and, at the same time, avoid a quarter of a million premature deaths, and 26 million tonnes of crop yield loss per year from reduced ozone air pollution (UNEP & CCAC, 2021).

Globally, agriculture is the largest source of methane accounting for 40%, followed by fossil fuels (35%) and waste (20%). Livestock make the largest contribution to agricultural emissions through enteric fermentation and manure management, followed by rice cultivation (UNEP & CCAC, 2021). Another source of methane is waste generation, where methane is released from the decomposition of organic matters or burning of solid wastes in municipal landfills. The majority of municipal solid wastes (MSWs) come from residential sources (56.7%) (kitchen waste, paper and cardboards, yard waste, etc.) while the second largest contributor comes from commercial sources (27.1%) such as business establishments and public/private markets (EMB, 2018). Methane capture is typically combined with electricity generation. In doing so, methane reduction does not only address climate-related risks but also provide clean and renewable energy.

Like methane, black carbon has a much shorter lifetime than CO_2. Black carbon is in the atmosphere for only a handful of days. Taking action to reduce black carbon emissions begets almost immediate results. Black carbon is very effective at absorbing light and has a global warming potential 1,500 times stronger than CO_2. Black carbon is also a constituent of fine particulate matter and therefore poses a significant risk to human health. For ground level or tropospheric ozone, this SLCP has a short lifetime of hours to weeks. Its global warming potential is roughly 1,000 times greater than carbon dioxide and impacts both crop production and human health (Lefohn et al., 2018). Meanwhile, HFCs do not have a direct health impact but are completely man-made substances, which have a lifespan of approximately 15 years and have a very high global warming potential, roughly 3,790 times that of CO_2.

1.4. Air pollution in Uganda

Air pollution is a growing concern in Uganda. The issue made headlines in 2025[1] as a recent study from Makerere University demonstrated that the air quality in Kampala substantially exceeds the World Health Organisation's (WHO's) air quality guideline threshold for $PM_{2.5}$ and contributed 7,257 deaths in the city over the 4-year study period (Atuyambe et al. 2024). At the national scale, the average $PM_{2.5}$ concentration is estimated to be 34 µg/m^3, almost 7 times higher than the WHO guideline value for the protection of human health (IHME, 2024). This makes air pollution the second largest risk associated with premature mortality in Uganda, accounting for almost 29 thousand deaths nationally (Figure 1.2).

In response, the Government of Uganda published National Air Quality Standards under the National Environment Act (Government of Uganda, 2019). The National Environment (Air Quality Standards) Regulations stipulate air quality standards and tolerance limits (Government of Uganda, 2024). Table 1.1. shows the standards for ozone and $PM_{2.5}$. These standards aim to curb the detrimental impact of poor air quality. The national standards also stipulate that the National Environment Management Authority (NEMA) shall develop a national air quality monitoring programme and a national air quality management plan for how these standards will be met.

This plan provides information relevant for the development of a national air quality management plan because it provides a first emission inventory for Uganda that quantifies emissions of SLCP and air pollutants. This allows the major sectors that emit air pollutant that need to be targeted to meet national air quality standards to be identified. The plan also identifies 19 mitigation actions to reduce SLCPs, and shows their effectiveness at also reducing air pollutants at the same time.

Table 1.1. Criteria for Ambient Air Quality Standards and Tolerance Limits from Uganda's National Environment (Air Quality Standards) Regulations (Government of Uganda, 2024).

Pollutant	Time-weighted average	Standard for ambient air (µg/m^3)
Ozone	24-hour	235
	8-hour	120
$PM_{2.5}$	Annual average	25
	24-hour	35

[1] How dirty air is sending Ugandans to early graves https://www.monitor.co.ug/uganda/special-reports/how-dirty-air-is-sending-ugandans-to-early-graves-4927378

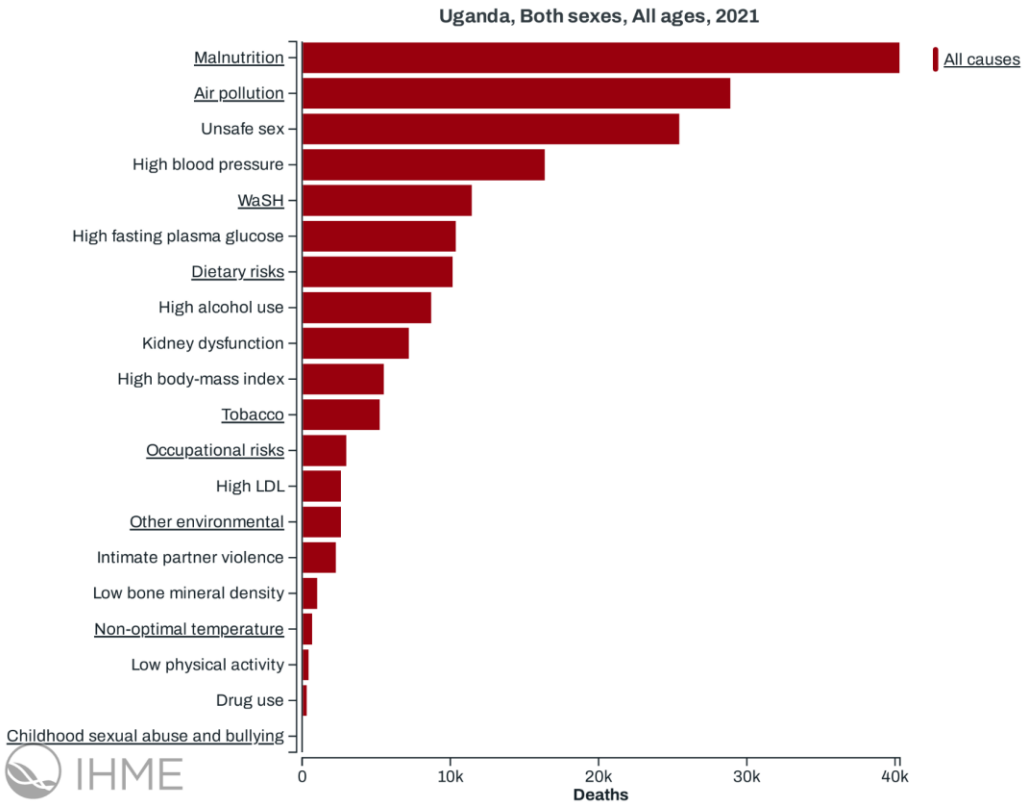


Figure 1.2. Number of premature deaths by risk factor in Uganda (2021). Source: IHME (2025).

1.5. Climate Change in Uganda

Historically, Uganda has contributed very little to global greenhouse gas emissions. In 2022, Uganda contributed less than 1% of total greenhouse gas emissions (excluding emissions from land use change) (Crippa et al. 2023). Despite this, it is one of the countries most vulnerable to the impacts of climate change (University of Notre-Dame, 2024). Uganda's vulnerability to climate change is exacerbated by the importance of agriculture, fisheries, tourism, and forestry in the national economy (The World Bank Group, 2021). This is compounded by high levels of poverty and infrastructure which is vulnerable to natural disasters (The World Bank Group, 2021). For example, climate change could disrupt rain-fed agriculture, shorten growing seasons and increase the heat stress experienced by cattle.

Despite its small contribution to global emissions, Uganda is a signatory of the Paris Agreement and in its 2022 NDC committed to reducing total greenhouse gas emissions by 24.7% by 2030 compared to the business-as-usual scenario (Ministry of Water and Environment, 2022a). The NDC identifies the Land Use and Land use Change and Forestry (LULUCF) sector as the largest source of greenhouse gas emissions accounting for 60% of national emissions. This is followed by the agriculture, energy, and waste accounting for 27%, 11% and 2% of emissions respectively. These key sources are also common sources of SLCPs.

At present, 90% of Uganda's final energy consumption is met by biomass, with electricity accounting for less than 2% (IEA, 2023). Hydropower is the main source of electricity. Uganda also has significant petroleum resources that to date have not been exploited. Uganda intends to produce 250 thousand barrels of oil per day by 2030 (IEA, 2023). The development of the oil and gas sector in Uganda could present trade-offs between development and climate, but also have implications for SLCP emissions, especially methane emissions from venting, flaring and leaks within the oil and gas production, processing and distribution infrastructure. To mitigate this risk, the Government introduced the Petroleum (Exploration, Development and Production) Act 2013 which restricts flaring or venting (Government of Uganda, 2013).

There is a strong overlap in the key greenhouse gas source sectors identified in Uganda and potential sources of SLCPs and air pollutants. There is therefore an opportunity to take integrated action on greenhouse gases and air pollutants, both to contribute to Uganda's climate commitments, but also to contribute to adaptation and public health benefits.

1.6. Aims and objectives of the SLCP Plan and Methane Roadmap

This Plan describes the integrated assessment of SLCPs in Uganda. It includes a roadmap for methane mitigation as well as presenting the potential synergies with the mitigation of greenhouse gases and other air pollutants. Its overarching aim is to identify, evaluate, and highlight a set of concrete, specific mitigation measures that could be integrated into Uganda's air pollution and climate change planning and whose implementation would result in simultaneous benefits locally in Uganda through improved air quality, and globally through reductions in Uganda's contribution to climate change. This report includes practical actions and recommendations as to policies and measures that would allow Uganda to simultaneously achieve multiple national and international commitments, through the development of national and regional Clean Air Plans, enhancing climate change mitigation targets in NDCs, and Uganda's commitment to the Paris Agreement. To achieve these aims, the report's objectives are:

- To highlight the existing SLCP activities in Uganda and review the planning and implementation framework for air quality and climate change management (Section 1).
- To present the first integrated SLCP, air pollutant, and greenhouse gas emission inventory for Uganda and identify major emission source sectors (Section 2).
- To evaluate the SLCP emission reduction potential in Uganda. This is done through quantifying the emission reductions of specific policies and measures in major emitting source sectors. The Plan also aims to highlight the co-benefits and potential trade-offs between different pollutants (Section 3).
- To quantify the human health impact of air pollutant emissions in Uganda to demonstrate the co-benefits of taking action on SLCPs in Uganda (Section 3.3).
- To understand how measures can practically be implemented in Uganda. This is achieved through developing implementation pathways and providing recommendations on requirements to achieve these pathways (Section 4).
- Make recommendations on how the implementation of SLCP actions can be monitored and evaluated over time (Section 5).

1.7. Institutional framework and the role of a SLCP Plan in Uganda

The Government of Uganda has made substantial efforts over the past five years to increase its capacity to understand and mitigate SLCPs. Uganda joined the Climate and Clean Air Coalition in 2021 and Uganda's 2022 NDC provides a clear mandate for the development of an SLCP Plan. Section 3.8 of Uganda's 2022 NDC states Uganda's commitment to undertaking integrated action that simultaneously improves air quality and mitigates climate change. It specifically states that this will be achieved through development of national ambient air quality regulations and standards, development of a national inventory of SLCPs and air pollutants and by integrating climate and clean air strategies. The national air quality standards have now been published (see Section 1.5 above). This SLCP Plan and methane roadmap comprises an integrated national inventory of SLCPs, air pollutants and greenhouse gases and constitutes the plan which integrates actions to address air pollution and climate change together. This Plan identifies specific actions that will reduce greenhouse gases and SLCPs like methane, but that will also have benefits for air pollution reductions. Through the Climate and Clean Air Coalition, Uganda is also implementing sectoral projects to reduce SLCPs for heavy duty vehicles and clean cooking.

This SLCP plan complements and enhances existing climate change mitigation and air pollution policy and planning activities in Uganda (Figure 1.3). Figure 1.3 shows the legal, planning, implementation and monitoring pathways for climate change in Uganda, and how the SLCP Plan provides information and actions to enhance these pathways.

Legal Basis for air pollution and climate change planning

The 2019 National Environment Act (the National Environment Act Cap.181) establishes the environmental regulatory and legislative framework for climate change and air pollution planning in Uganda (Government of Uganda, 2019). It explicitly identifies climate change as an emerging environmental issue and outlines the roles and responsibilities of NEMA to put in place measures to address the impacts of climate change, including reducing emissions from deforestation and forest degradation. The Act also stipulated the requirement to develop National Air Quality Standards, developed and implemented by NEMA.

The Environment Act defines the responsibilities of NEMA and the Policy Committee on Environment. The Committee is chaired by the Prime Minister and consists of sectoral and local Government Ministers. It is responsible for strategic policy guidance on environment in Uganda. The Committee provides guidance to the Climate Change Department (CCD) and NEMA on the formulation, harmonisation, and implementation of environmental and climate change policies, plans and programmes as well as liaising with cabinet and advising on legislative proposals. NEMA is responsible for enforcing the Environmental Act as the principal agency for regulating, monitoring, supervising and coordinating all activities relating to the environment in Uganda. Furthermore, NEMA advises on the formulation and implementation of environmental and climate change policies, plans and programmes and support the implementation of multilateral environmental agreements and treaties. NEMA is also responsible for prescribing air quality and emission standards and regulating air pollution and greenhouse gas emissions. NEMA and the Policy Committee on Environment will therefore play a critical role in implementing and enforcing the actions in the SLCP Plan.

Uganda has ratified the Paris Agreement and in 2021 The National Climate Change Act (Cap.182) was adopted to give the force of the law in Uganda to the UNFCCC, Kyoto Protocol,

and the Paris Agreement. This Act provides the regulatory framework for monitoring, reporting, and verifying the impact and mitigation of climate change. It also provides the institutional framework to coordinate, supervise, regulate and manage all climate change related activities. The National Climate Change Act defines the responsibilities of the CCD within the Ministry of Water and Environment. The Ministry is a cabinet entity responsible for the management of water and environmental resources. Under the Ministry, the CCD is the focal point for the UNFCCC and is responsible for ensuring Uganda meets its obligations in the Paris Agreement. CCD coordinate national climate actions and provide technical support to the Permanent Secretary of the Ministry of Water and Environment. CCD also initiate the development of appropriate polices, laws, and programmes for the implementation of climate adaptation and mitigation activities and monitors and evaluates programmes and actions of Government on climate change.

Air Quality Management Planning and Monitoring

Uganda has already made efforts to integrate air pollution and climate change planning. Uganda's 2022 NDC provides a commitment to develop a National SLCP emission inventory so that major sources can be identified and monitored. This National SLCP Plan and methane roadmap meets this commitment. The SLCP Plan meets this requirement by providing an evidence base for SLCP management. The SLCP emissions inventory was developed using the Low Emission Analysis Platform (LEAP). This is an integrated energy and emissions modelling tool which allows the user to holistically quantify emissions of SLCPs, air pollutants and greenhouse gases across all source sectors. The results of this integrated emission inventory are presented here and were used as the evidence base for this SLCP Plan. The emissions inventory includes historic emissions and is used to quantify key polluting source sectors. While this plan provides an SLCP emission inventory that was developed separately from Uganda's national GHG inventory, ultimately, it would be most efficient for updates to the SLCP emission inventory to be integrated into the national greenhouse gas emission inventory and reporting carried out by the CCD of the Ministry of Water and Environment. There is substantial overlap in the data needed to quantify SLCP and greenhouse gas emissions, and therefore the most efficient approach to developing emission inventories covering all greenhouse gases, SLCP, and air pollutants is to develop an integrated inventory encompassing all pollutants.

The National Air Quality Standards stipulate the requirement of an air quality monitoring programme and management plan. The National SLCP Plan and methane roadmap helps to identify and evaluate actions which could be the foundation for this air quality management plan. The LEAP model used to evaluate SLCPs and air pollutant emissions includes emission projections based on socio-economic data from the Uganda Vision 2040 and energy projections in the Energy Transition Plan (IEA, 2023). The SLCP Plan includes the key results from this mitigation assessment in which sectoral mitigation measures in existing national policy documents have been evaluated. Existing policies and plans included in the 2022 NDC as well as sectoral plans were used to inform the SLCP Plan mitigation assessment. Uganda is also a signatory of the Kigali Amendment to the Montreal Protocol (UNEP, 2019) meaning it has committed to the phase out of ozone depleting substances, including HFCs. The phase out regime prescribed in the Amendment determined the HFC mitigation measures included in the SLCP plan. The mitigation measures modelled in the Plan are detailed in Sections 3.2 and 4. The air pollutant emission reductions achieved from implementation of these actions are

included within the Plan, and the most effective measures could be included within the air quality management plan.

Climate Change Planning

Uganda has ratified the Paris Agreement which requires countries to submit NDCs every 5 years with the next update in 2025. Uganda's NDC fits within a broader national and international climate change planning and reporting framework in Uganda, and therefore a key way in which the National SLCP Plan can help achieve SLCP emission reductions is through the incorporation of the Plan's elements within the NDC. This Plan includes quantified emission reductions that could be achieved through implementing a package of sectoral measures. These measures, and their potential to mitigate emissions, can be used to inform the targets and sectoral pathways included in the NDC. For example, this plan provides a detailed basis for specific targets to reduce SLCPs, which could be included in the updated NDC. Prioritisation of the actions within this plan to achieve an overall greenhouse gas reduction target would also ensure that SLCPs and air pollutants are reduced alongside greenhouse gases.

The NDC is drafted by the CCD in the Ministry of Water and Environment. It is developed with sectoral experts that make up the NDC Technical Working Group (NDC-TWG). The draft NDC is then reviewed by the Policy Committee on Environment and then approved by the Office of the Prime Minister.

Implementing climate action in Uganda

The priority measures and policies in the NDC then inform Uganda's National Development Plan. The National Planning Authority are responsible for producing a National Development Plan every 5 years. This guides the short-term socio-economic direction of the country and is used to determine 5-year budgets for each government sector. The SLCP Plan can also help to directly inform the development programmes included in the National Development Plan. For example, the National Development Plan includes core projects which are "high multiplier projects" that deliver key results of the Development Plan. The SLCP Plan can be used to define programme objectives and determine core projects which maximise co-benefits and simultaneously address several national development goals. The most recent National Development Plan (NDPIII) (National Planning Authority, 2020) included 5 strategic objectives such as enhancing the productivity and social wellbeing of the population and strengthen the private sector capacity to drive growth and create jobs. Given the cross-cutting nature of SLCP mitigation, there is the potential to address several of these objectives simultaneously. Ensuring that the impact of potential budget items on SLCP and air pollutant emissions as well as greenhouse gases can ensure that national budget is allocated to actions that benefit human health and mitigate climate change.

The Ministry of Finance, Planning and Economic Development prepares and coordinates the annual sector budgets and then sectoral agencies, such as NEMA, are responsible for implementing the development programmes and projects defined in the National Development Plan. Projects are implemented through both national government funding, as well as private sector initiatives and support from development banks. The NDPIII identified multilateral creditors as an important source of financing while domestic financing was limited so as not to constrain private sector investment and growth. The SLCP Plan can be applied to attract external investment as it can be used to provide evidence the climate and health benefits of

projects. The LEAP emission analysis developed to inform the SLCP Plan is a tool that can be tailored to evaluate the specific benefits of particular potential projects.

Monitoring Implementation

The Office of the Prime Minister monitors the implementation of measures and projects. NEMA is also the regulatory body that is responsible for ensuring compliance with and enforcing the National Environmental Act and the National Air Quality Standards. It has the authority to collect fees and issue fines when regulations are contravened. Revenue from fines and environmental levies contribute to the National Environment Fund, which is also supplemented by disbursements from the government. The fund supports the implementation of ecosystem management and restoration, compliance with social impact assessments and audits, environmental research, and innovative environmental management. If measures are found to be successful in mitigation emissions and their associated impacts, or if they are not, the sectoral measures are then reviewed in response to this. The measures outlined in this SLCP Plan can then also be reviewed to monitor progress and revise measures when required. Climate planning is also monitored through submissions to the United Nations Framework Convention on Climate Change (UNFCCC) including through Biennial Transparency Reports, National Communications, and National Inventory Reports. Section 5 provides recommendations on how the implementation of SLCP measures can be monitored and integrated with the existing climate monitoring framework.

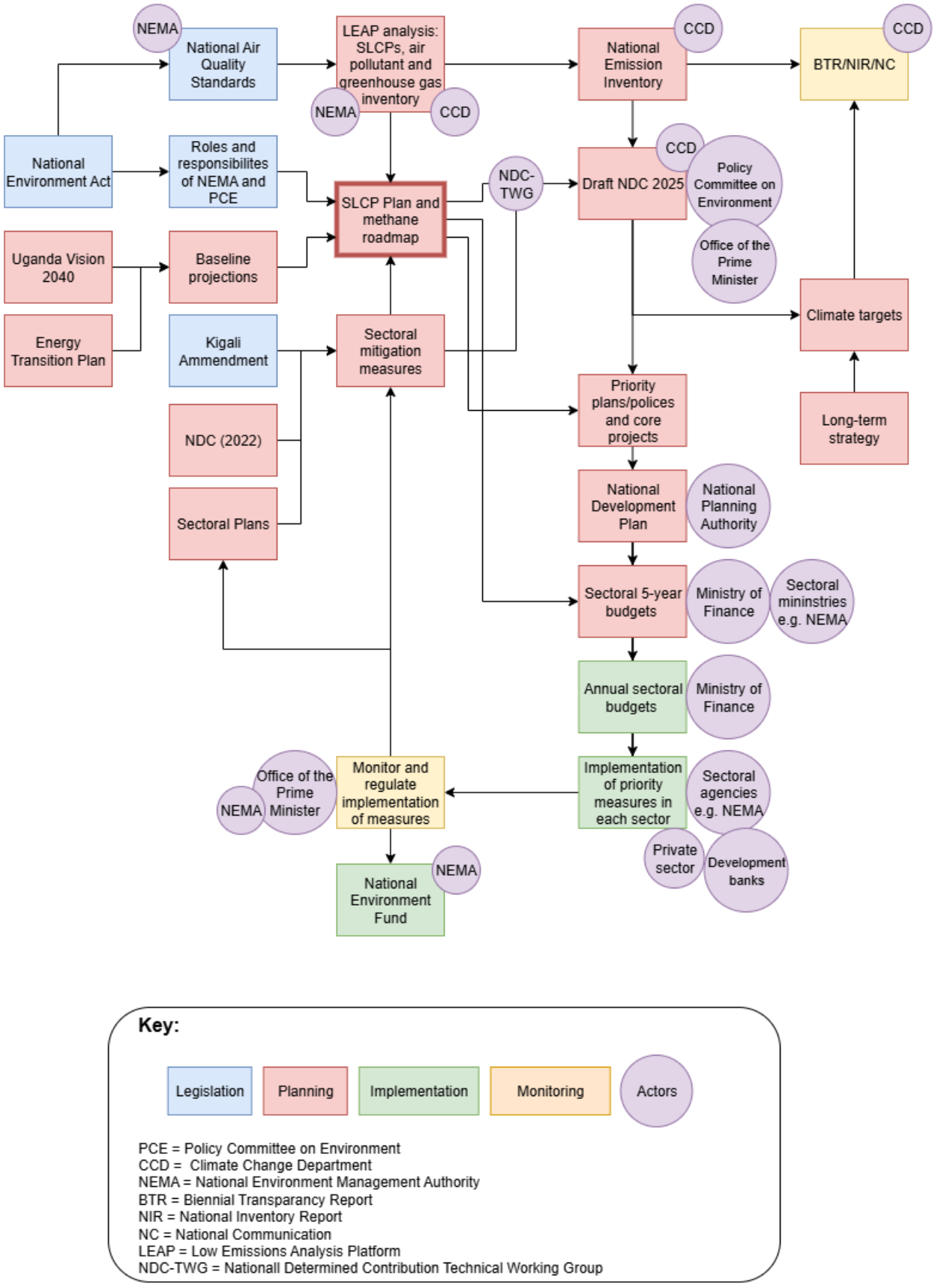


Figure 1.3. The role of the SLCP Plan within existing climate and air quality infrastructure and the mechanism by which SLCP actions can be implemented.

2. Short-Lived Climate Pollutant emission sources in Uganda

2.1. Objectives of the SLCP Mitigation Assessment

Sections 2 and 3 in this report present the results of the SLCP mitigation assessment. The assessment forms the evidence base for the Plan and aims to:

- Estimate historic SLCP emissions (methane, black carbon, HFCs) in Uganda between 2014 and 2019.
- Quantify the contribution of major source sectors of SLCPs between 2014 and 2019.
- Project emissions into the future (2030, 2035, 2040) for a baseline (or business as usual) scenario reflecting socioeconomic development in Uganda without implementation of new policies or measures designed to reduce emissions.
- Quantify the reduction in SLCP emissions through the implementation of specific policies and measures in major emitting source sectors. The policies and measures evaluated in the mitigation assessment include policies and measures included in existing plans and strategies in Uganda, as well as additional policies and measures whose implementation could further reduce emissions, improve air quality, and mitigate climate change in Uganda.
- Estimate emissions of greenhouse gases (CO_2 and Nitrous Oxide) and air pollutants (particulate matter, organic carbon, nitrogen oxides, ammonia, non-methane volatile organic carbons, and sulphur dioxide) to demonstrate the co-benefits of taking action on SLCPs in Uganda.
- Quantify the human health impacts in each scenario to demonstrate the opportunity for achieving multiple benefits.

To understand the importance of the SLCPs in Uganda as well as how to tackle the issue, we need to first understand the magnitude of emissions in Uganda, and where these emissions are coming from. Doing so allows the sectors with the largest emissions of key pollutants, and therefore the primary targets for mitigation, to be identified. It also allows the emission source sectors which emit a range of different air pollutants, SLCP, and greenhouse gases to be identified so that those sectors where mitigation measures could simultaneously contribute to reductions in multiple pollutants can be targeted.

2.2. Estimation of SLCP emissions in Uganda

Summary of methods

Emissions were estimated from all key emitting source sectors following the Intergovernmental Panel for Climate Change (IPCC) category classifications. These include emissions from energy, Industrial Processes and Product Use (IPPU), agriculture, and waste (solid waste and wastewater). Historic emissions were estimated for the years 2014-2019 as these are the years

for which sufficient data was available for all sectors analysed. Emissions from each source sector were calculated as the product of an activity data and emission factor:

Equation 1

$$Emissions = Activity\ Variable\ x\ Emission\ Factor$$

Activity data was taken primarily from the Uganda Bureau of Statistics (UBOS), national reports such as the National Service Delivery Survey (Uganda Bureau of Statistics, 2021) and the National Census Reports (Uganda Bureau of Statistics, 2002; Uganda Bureau of Statistics, 2014; Uganda Bureau of Statistics, 2024a). The analysis was guided and reviewed by sectoral experts who also provided additional data, such as National Energy Balances (Ministry of Energy and Mineral Development, 2024). Emissions of SLCPs in Uganda were estimated using the Low Emissions Analysis Platform (LEAP) tool (Heaps, 2022). A more detailed methodology is provided in the Technical Annex accompanying this Plan.

Methane emissions

In 2019, total methane emissions are estimated to be 1.0 million tonnes (Table 2.1). The largest source of methane in Uganda is agriculture (Figure 2.1). Specifically, enteric fermentation of livestock, accounting for 720 thousand tonnes in 2019 (Table 2.1), or 71% of total methane emissions. Cattle (dairy and non-dairy) produce the most methane. It was assumed that cattle are reared in a low productive system based on the most recent livestock census (MAAIF, 2024). Other substantial sources of methane emissions include residential energy demand and waste which account for 11% and 9% of total methane respectively. In 2020, 87% of urban households, and 97% of rural households cook with either wood or charcoal (Uganda Bureau of Statistics, 2021). This high residential demand for charcoal as well as demand in the commercial and services sector leads to associated charcoal production, which is also a source of methane. Waste is also a notable source of methane, accounting for 92 thousand tonnes in 2019. Solid waste disposal and wastewater treatment both contribute to emissions. In historic years, it was assumed that only 60% of solid waste is collected in urban areas and of this collected waste, 83% goes to landfill (JICA et al., 2022). Due to the lack of data on waste management in rural areas, it was assumed that less than 1% of households have their waste collected (Uganda Bureau of Statistics, 2024b), but that none of this waste goes to landfill. The main source of methane from solid waste management is therefore from urban waste which is collected. Industrial wastewater only accounts for 13% of emissions, with the remaining wastewater methane coming from households. The majority of households in both urban and rural areas manage wastewater in latrines (Uganda Bureau of Statistics, 2021), therefore this is the most significant source of methane from liquid waste.

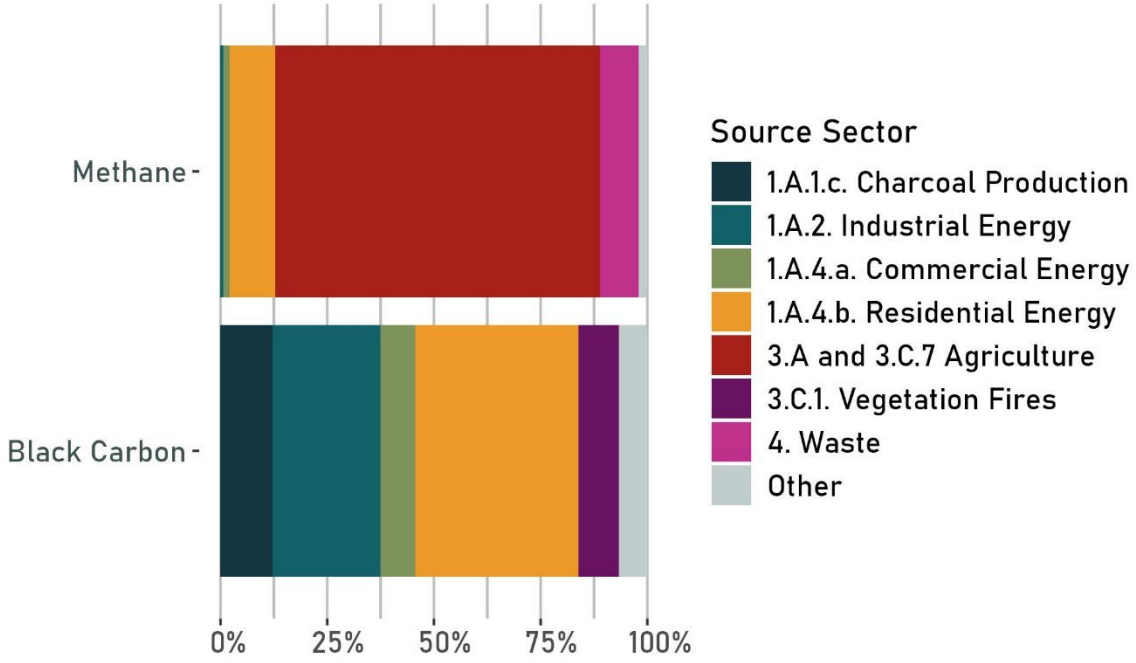


Figure 2.1. Key SLCP emission sources in Uganda. The percent contributions by source sector of total methane and black carbon emissions.

Table 2.1. Methane emissions in Uganda in historic years (2014-2019) and projected to 2030, 2035, and 2040 (thousand metric tonnes).

IPCC Category Code	IPCC Category	2014	2015	2016	2017	2018	2019	2030	2035	2040
1	**ENERGY**	108	113	116	126	134	138	216	256	312
1.A.1	Energy Industries	4.05	4.79	6.05	12.6	9.55	7.45	14.4	18.8	24.7
1.A.1 a	Main Activity Electricity and Heat Production	0.09	0.06	0.06	0.06	0.08	0.07	0.35	0.35	0.35
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries	4	5	6	13	9	7	14	18	24
1.A.2	Manufacturing Industries and Construction	2.89	3.55	2.92	2.93	4.44	6.16	15.7	23.4	34.4
1.A.3	Transport	0.66	0.66	0.67	0.69	0.69	0.70	1.39	1.85	2.45
1.A.3.a	Civil Aviation	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0050	0.0070	0.0100
1.A.3.b	Road Transportation	0.65	0.65	0.66	0.67	0.68	0.69	1.34	1.79	2.36
1.A.3.c	Railways	0.0040	0.0050	0.0050	0.0060	0.0060	0.0060	0.0110	0.0140	0.0180
1.A.3.d	Water-borne Navigation	0.0080	0.0090	0.0090	0.0100	0.0110	0.0110	0.0270	0.0390	0.0580
1.A.4	Other Sectors	100	104	107	109	120	124	167	199	242
1.A.4.a	Commercial/Institutional	7	8	7	7	15	16	40	61	91
1.A.4.b	Residential	93	96	99	102	105	108	126	138	150
1.A.4.c	Agriculture/Forestry/ Fishing/Fish Farms	0.02	0.04	0.06	0.06	0.07	0.07	0.13	0.17	0.21
1.B.2	Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	17	13	9
3	**AGRICULTURE, FORESTRY, AND OTHER LAND USE**	936	889	839	837	813	786	1096	1229	1379
3.A	Livestock	905	858	810	807	783	756	1065	1198	1347
3.A.1	Enteric Fermentation	863	818	772	770	746	720	1015	1142	1285
3.A.2	Manure Management	41	40	38	38	37	36	50	56	62
3.B	Land	0	0	0	0	0	0	0	0	0
3.C	Aggregate Sources and Non-CO2 Emissions Sources on Land	14	13	13	13	13	13	15	15	15

3.C.1	Emissions from Biomass Burning	14	13	13	13	13	13	15	15	15
3.C.7	Rice Cultivation	18	18	16	17	17	17	17	17	17
4	**WASTE**	73	77	81	84	88	92	184	232	291
4.A	Solid Waste Disposal	34	36	38	40	43	45	111	143	181
4.B	Biological Treatment of Solid Waste									
4.C	Incineration and Open Burning of Waste	1.3	1.3	1.4	1.4	1.5	1.5	2.1	2.4	2.8
4.D	Wastewater Treatment and Discharge	38	40	41	42	44	45	71	87	108
Total		**1,117**	**1,079**	**1,036**	**1,047**	**1,035**	**1,016**	**1,496**	**1,717**	**1,983**

Black carbon emissions

In 2019, total black carbon emissions in Uganda are estimated to be 25 thousand tonnes (Table 2.2). The largest source of black carbon is the residential sector accounting for 38% of total black carbon emissions (Figure 2.1). Traditional biomass cookstoves are prevalent in Uganda and residential black carbon emissions are almost exclusively from cooking, primarily from rural households. Based on data from the 2024 census (Uganda Bureau of Statistics, 2024a) and the 2023 statistical abstract (Uganda Bureau of Statistics, 2023) we estimate 72% of households to be classified as rural in 2019. Of these rural households, 31% cook with wood which contributes 8 thousand tonnes of black carbon, or 86% of residential black carbon emissions. The second largest source of black carbon is industrial energy use, followed by charcoal production (Table 2.2). Industrial energy accounts for 25% of black carbon emissions with the consumption of wood and 'other biomass' (not including charcoal) fuels being the most substantial source within the sector. In 2020, the industrial sector consumed almost 2 million tonnes of oil equivalent (TOE) of wood and 2.4 million TOE of 'other biomass' (Ministry of Energy and Mineral Development, 2024). In previous years industrial energy use is not broken down by sub-sector, but in 2020 the food, beverage, and tobacco industry is reported as the highest consumer of wood fuel, while the non-metallic minerals industry is the largest consumer of 'other biomass' fuels. Charcoal accounts for 12% of black carbon emissions in 2019. Based on the demand for charcoal in the residential, industrial and commercial sectors, we estimate that there was 1.6 million TOE of charcoal produced in 2019. Efficiency of charcoal kilns was calculated from the African Union Energy Commission energy balance for Uganda (AFREC, 2023) and the average across historic years was 23%. This is assuming that all charcoal that is consumed, is produced in Uganda.

Table 2.2. Black carbon emissions in Uganda in historic years (2014-2019) and projected to 2030, 2035, and 2040 (thousand metric tonnes).

IPCC Category Code	IPCC Category	2014	2015	2016	2017	2018	2019	2030	2035	2040
1	**ENERGY**	15	17	17	20	20	21	39	52	71
1.A.1	**Energy Industries**	1.6	1.9	2.5	5.1	3.9	3.0	5.8	7.6	10
1.A.1 a	Main Activity Electricity and Heat Production	0.013	0.0090	0.0090	0.0090	0.012	0.011	0.052	0.052	0.052
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries	1.6	1.9	2.5	5.1	3.9	3.0	5.7	7.6	10
1.A.2	**Manufacturing Industries and Construction**	3.8	4.7	3.9	3.9	4.5	6.2	16	24	35
1.A.3	**Transport**	0.36	0.37	0.38	0.40	0.42	0.43	0.87	1.2	1.6
1.A.3.a	Civil Aviation	0.011	0.010	0.010	0.010	0.011	0.0080	0.021	0.030	0.044
1.A.3.b	Road Transportation	0.30	0.30	0.31	0.33	0.34	0.35	0.72	0.97	1.3
1.A.3.c	Railways	0.036	0.043	0.046	0.048	0.053	0.54	0.092	0.12	0.15
1.A.3.d	Water-borne Navigation	0.012	0.013	0.014	0.015	0.017	0.016	0.041	0.060	0.088
1.A.4	**Other Sectors**	9.3	10	10	10	11	12	16	20	25
1.A.4.a	Commercial/Institutional	0.94	1.0	1.0	1.0	1.9	2.0	5.3	8.0	12
1.A.4.b	Residential	8.3	8.5	8.7	8.9	9.2	9.4	11	11	12
1.A.4.c	Agriculture/Forestry/Fishing/ Fish Farms	0.09	0.12	0.15	0.17	0.18	0.18	0.36	0.45	0.57
1.B.2	**Oil and Natural Gas**									
2	**INDUSTRIAL PROCESSES AND PRODUCT USE**	0.45	0.49	0.51	0.53	0.54	0.65	1.8	2.7	3.9
2.A	Mineral Industry	0.45	0.49	0.51	0.53	0.54	0.65	1.8	2.7	3.9
3	**AGRICULTURE, FORESTRY, AND OTHER LAND USE**	2.6	2.5	2.5	2.5	2.5	2.5	2.8	2.8	2.8
3.A	Livestock									

3.A.1	Enteric Fermentation									
3.A.2	Manure Management									
3.C	Aggregate Sources and Non-CO2 Emissions Sources on Land	2.6	2.5	2.5	2.5	2.5	2.5	2.8	2.8	2.8
3.C.1	Emissions from Biomass Burning	2.6	2.5	2.5	2.5	2.5	2.5	2.8	2.8	2.8
3.C.7	Rice Cultivation									
4	**WASTE**	0.23	0.24	0.25	0.25	0.26	0.27	0.37	0.43	0.50
4.A	Solid Waste Disposal									
4.B	Biological Treatment of Solid Waste									
4.C	Incineration and Open Burning of Waste	0.23	0.24	0.25	0.25	0.26	0.27	0.37	0.43	0.50
4.D	Wastewater Treatment and Discharge									
	Total	18	20	20	23	23	25	44	58	78

Hydrofluorocarbon (HFC) emissions

HFC-134a was the only HFC included in this analysis as it was the only HFC with data available (Ministry of Water and Environment, 2022b). The majority of HFCs are used in air conditioning and refrigeration, while a small proportion is used in fire protection (Figure 2.2). Total HFCs in 2019 were 74 tonnes, which in terms of the 100-year global warming potential, is equivalent to 91 thousand tonnes of CO_2. It was assumed that all HFCs consumed are imported into Uganda. HFCs consumption increased from 2014 to 2017, but there was no data on HFC consumption after 2017 so consumption was assumed to stay constant between 2017 and 2019.

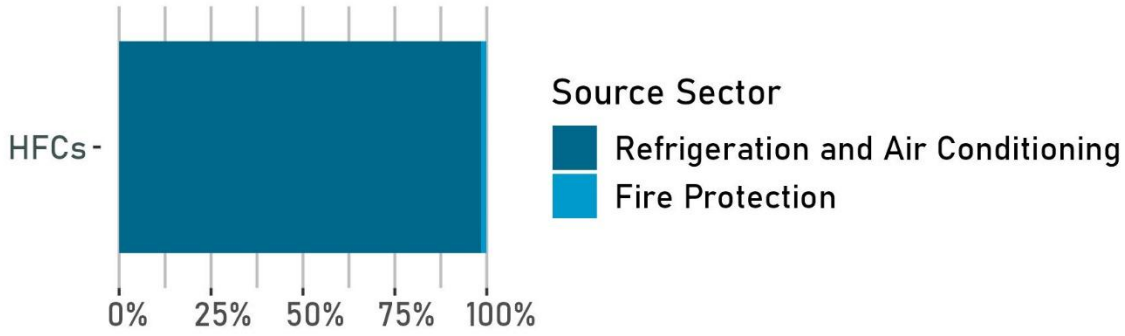


Figure 2.2. HFC-134a is primarily used for refrigeration and air conditioning.

2.3. Co-emitted pollutants

Sources of SLCPs are commonly also sources of greenhouse gases and other air pollutants. In 2019 there was 5.7 million tonnes of CO_2 and 16 thousand tonnes of nitrous oxide (N_2O) emitted in Uganda (Table 2.3). Fine particulate matter ($PM_{2.5}$) is an important pollutant due to its damaging impact on human health and emissions are estimated to have reached 211 thousand tonnes in 2019 (Table 2.3). Alongside methane, nitrogen oxides, carbon monoxide, ammonia, non-methane volatile organic compounds, and sulphur dioxide all contribute to the formation of ground-level ozone which is a toxic pollutant impacting human health and crop yields. Emissions of these ozone precursors are also presented in Table 2.3.

Table 2.3. National SLCP, greenhouse gas, and air pollutant emissions in 2019. Emissions are shown in thousand metric tonnes. NMVOCs = Non-Methane Volatile Organic Compounds.

Source Sector Category	Source Sector Description	HFC-134a	Organic Carbon	Black Carbon	PM2.5	Ammonia	Sulphur Dioxide	PM10	Nitrous Oxide	Nitrogen Oxides	NMVOCs	Methane	Carbon Monoxide	Carbon Dioxide
1.A.4.c	Agricultural Energy Demand	-	0.115	0.183	0.419	0	0	0.428	0.004	4.51	0.251	0.069	0.769	494
1.A.4.a	Commercial and Services Energy Demand	-	3.74	2.04	7.27	1.92	0.00300	7.43	0.208	4.83	15.6	15.6	29.6	52.5
1.A.2	Industrial Energy Demand	-	11.2	6.22	21.9	0.0030	2.44	22.4	0.626	22.2	46.6	6.17	88.9	1164
1.A.4.b	Residential Energy Demand	-	46.6	9.4	103	19.4	0.00700	103	1.67	48.1	559	108	1,887	58.6
1.A.3	Transport	-	0.442	0.429	1.079	0.392	0.712	1.08	0.112	22.3	650	0.703	125	3,664
3.A & 3.C.7	Agriculture	-	0.776	0.118	1.27	201	0.113	1.34	12.5	44.0	0.118	774	15.7	-
3.C.1	Vegetation Fires	-	19.5	2.34	30.1	5.22	2.04	44.9	1.03	18.2	17.6	12.4	335	-
1.A.1.c	Charcoal Production	-	20.5	3.02	41.3	5.87	-	41.3	-	2.86	521	7	1,536	-
	Other	0.0740	2.22	0.925	5.05	0.465	1.41	6.02	0.0100	2.33	25.3	91.8	15.9	307
	Total	0.0740	105	24.7	211	235	6.73	228	16.1	169	1,835	1,016	4,033	5,740

There is a substantial overlap in the major sources of SLCPs, greenhouse gases, and air pollutants (Figure 2.3). For example, agriculture is the largest source of methane, nitrous oxide, and ammonia. It is also the second largest source of nitrogen oxides while energy demand in the agricultural sector is the third largest source of CO_2. The residential sector is the largest source of black carbon, particulate matter (PM_{10} and $PM_{2.5}$), organic carbon, carbon monoxide, nitrogen oxides, the second largest source of nitrous oxide, and ammonia, and contributes to methane emissions. Charcoal production, industry and vegetation fires follow the residential sector as a major source of particulate matter, black carbon, non-methane volatile organic carbons, nitrogen oxides, nitrous oxides, organic carbon, and carbon monoxide. Transport is the largest source of CO_2 and non-methane volatile organic compounds, while also contributing emissions of nitrogen oxides. Though it should be noted that CO_2 emissions from land use change were not included in this analysis, and in the 2022 National Communication (Ministry of Water and Environment, 2022b) this was reported as the largest source of CO_2 accounting for 56 million tonnes in 2017. In this analysis, industrial energy use was the second largest source of CO_2 as well as a major source of nitrogen oxides, particulate matter, black carbon, organic carbon, and sulphur dioxide.

2.4. Comparison of SLCP emissions inventory with national government data

The most recent national estimates of greenhouse gases can be found in the Third National Communication submitted to the UNFCCC (Ministry of Water and Environment, 2022b). The National Communication does not report black carbon emissions, but we can compare other pollutants. Table 2.4 shows the methane and CO_2 emissions estimated in this analysis, compared to the emissions reported in the National Communication.

Emissions of methane are consistent, particularly in the energy sectors. Emissions estimated here for the livestock sector are higher than those in the National Communication (807 vs 574). However, these discrepancies are due to the methodology and emission factors used. The National Communication used emission factors in the 2006 IPCC guidelines (IPCC, 2006), whereas in this analysis applied the updated 2019 guidelines (IPCC, 2019). The 2019 guidelines include updated Tier 1 emission factors for enteric fermentation, as well as updated methods and emission factors for manure management. For example, in the 2006 guidelines, the enteric fermentation emission factor for dairy cattle in Africa is 46 kg/head/year compared to 66 kg/head/year in a low productivity system, or 86 kg/head/year in a high productivity system in the 2019 guidelines. Therefore, enteric fermentation is a more significant source of emissions in Uganda than previously thought. Emissions from rice cultivation are slightly lower in this analysis than in the National Communication (Table 2.4). The rice area cultivated in this analysis is consistent with that of the National Communication (90 thousand vs. 97 thousand hectares), therefore, the discrepancy in emissions is likely due to differing assumptions made about rice water regimes. In this analysis it was assumed that 56% of rice is continuously flooded (irrigated) and 44% is rainfed (Laborte et al. 2017). However, the assumptions on rice water regime are not detailed in the National Communication so it is not possible to compare.

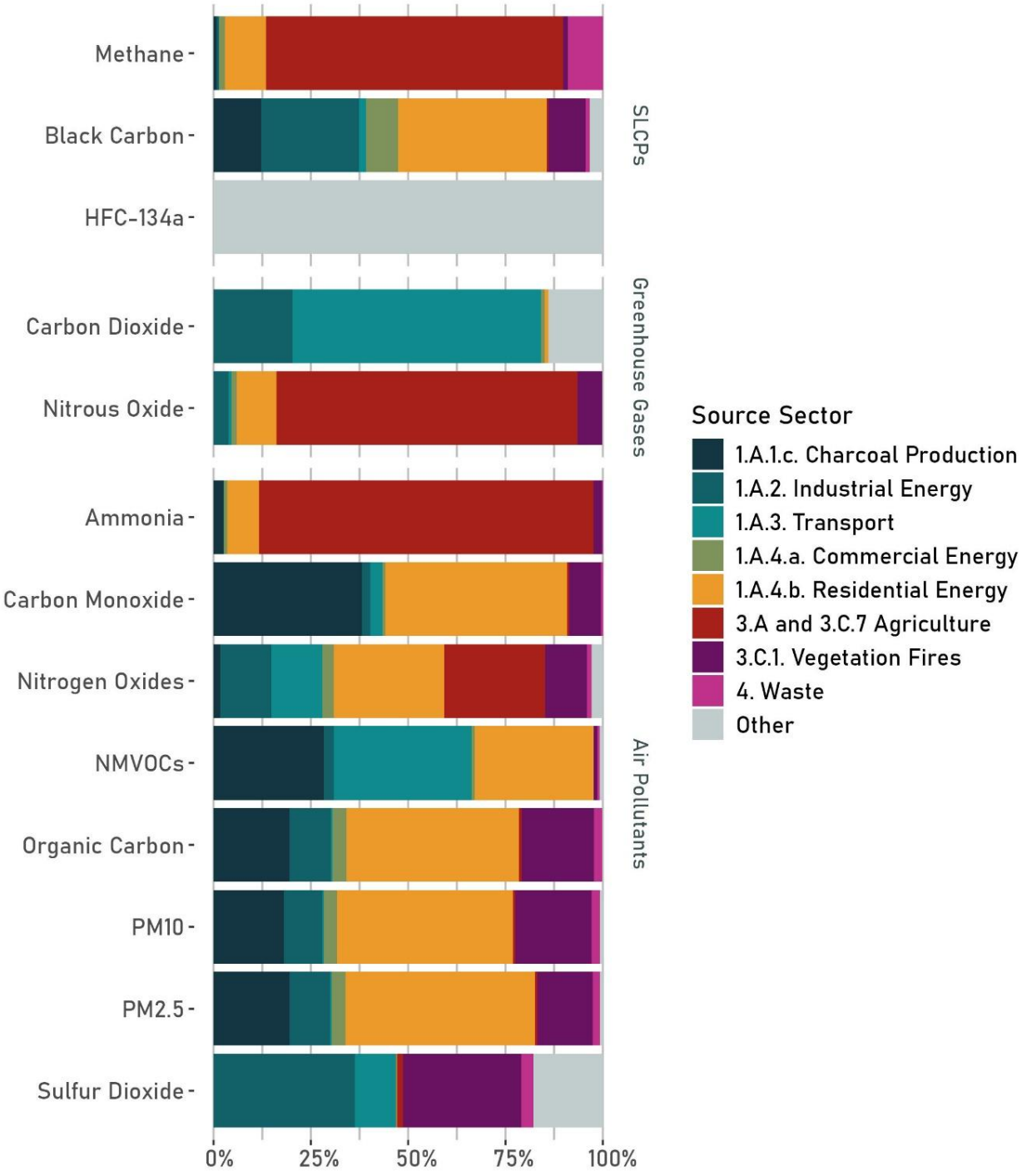


Figure 2.3. The overlap in sources of SLCPs, greenhouse gases, and air pollutants. Colours denote source sector category as defined in the IPCC Guidelines (IPCC, 2019). Emissions shown for year 2019. NMVOCs = Non-Methane Volatile Organic Compounds. Note, emissions from land use change are not included.

In addition, the rice methane conversion factors for different water regimes were updated in the 2019 IPCC guidelines. Emissions of methane from solid waste disposal are also underestimated in this analysis compared to the National Communication. This is likely attributable to the uncertainty in waste collection rate in Uganda, particularly in urban areas. The National Communication reports the waste generation rate in cities to be 0.55 kg/capita/day and applies this across urban and rural populations. In this analysis it was assumed that rural waste generation is lower, and is 0.37 kg/capita/day based on suburban areas in Kampala (Kampala Capital City Authority et al., 2020). It was also assumed that no rural waste goes to landfill based on the very low proportion (0.4%) of rural households that report their waste going to a waste vendor (Uganda Bureau of Statistics, 2024b). The proportion of waste that is collected in urban and rural areas is not reported in the National Communication.

The largest source of CO_2 in the National Communication is IPCC category 3.B, which accounts for emissions from land use change. As this is not a major source of SLCPs, it was not included in this analysis. Of the sectors that were included, CO_2 emissions estimated in this analysis show strong agreement with the National Communication and if category 3.B is excluded, total CO_2 emissions in this analysis are 5.6 million compared to 5.1 million tonnes in the National Communication (Table 2.4).

Emissions from mineral production, specifically cement production are higher in the National Communication compared to this analysis (343 thousand tonnes vs. 194 thousand tonnes) For year 2017, cement production in this analysis was taken directly from the National Communication. Therefore, the discrepancy in emissions is likely attributable to the clinker content that was assumed. This analysis used the IPCC (2019) default clinker content of 95% for Portland cement, and a median value of 60% for Pozzolan cement. However, the clinker content assumed in the National Communication was not reported.

Table 2.4. Comparison of methane and CO_2 emissions estimated here, with the emissions reported in the National Communication. Emissions are shown in thousand metric tonnes for year 2017.

IPCC Category Code	IPCC Category	Methane		CO_2	
		This analysis	National Communication	This analysis	National Communication
1	**ENERGY**	126	123.362	5387	4743
1.A.1	Energy Industries	12.6200	11.093	77	123
1.A.1 a	Main Activity Electricity and Heat Production	0.06	0.00497	77	123
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries	13	11.088	0	
1.A.2	Manufacturing Industries and Construction	2.93	2.06	1078	928
1.A.3	Transport	0.685	0.833	3542	3104
1.A.3.a	Civil Aviation	0.00		320	
1.A.3.b	Road Transportation	0.667	0.833	3021	3104
1.A.3.c	Railways	0.00600	0.00000030	102	0
1.A.3.d	Water-borne Navigation	0.0100		99	
1.A.4	Other Sectors	109	109	689	589
1.A.4.a	Commercial/Institutional	7.47	4.13	187	131
1.A.4.b	Residential	102	105	53	173
1.A.4.c	Agriculture/Forestry/Fishing/Fish Farms	0.062	0.04104	450	284
1.B.2	Oil and Natural Gas	0.00			
2	**INDUSTRIAL PROCESSES AND PRODUCT USE**	0		200	350
2.A	Mineral Industry	0		200	350
2.B	Chemical Industry	0			
2.C	Metal Industry	0			0.0125
2.D	Non-Energy Products from Fuels and Solvent Use	0			
2.E	Electronics Industry	0			

2.F		Product Uses as Substitutes for Ozone Depleting Substances	0			
2.F.1		Refrigeration and Air Conditioning	0			
2.F.3		Fire Protection	0			
2.G		Other Product and Manufacture Use	0			
2.H		Other	0			
2.H.1		Pulp and Paper Industry	0			
2.H.2		Food and Beverages Industry	0			
3	**AGRICULTURE, FORESTRY, AND OTHER LAND USE**		837	610		56474
3.A		Livestock	807	574		
3.A.1		Enteric Fermentation	770	551		
3.A.2		Manure Management	37.6	23.1		
3.B		Land		0		56470
		Aggregate Sources and Non-CO2		35.6		5.06
3.C		Emissions Sources on Land	12.9			
3.C.1		Emissions from Biomass Burning	12.9	11.7		
3.C.7		Rice Cultivation	16.7	24		
4	**WASTE**		84.2	289		8.89
4.A		Solid Waste Disposal	40.4	200		
4.B		Biological Treatment of Solid Waste	0.0	21.3		
4.C		Incineration and Open Burning of Waste	1.4	0.482		8.89
4.D		Wastewater Treatment and Discharge	42.3	67.3		
Total			**1,047**	**2,776**	**5,588**	**61,576**

3. Short-Lived Climate Pollutants mitigation measures in Uganda

There are a range of different mitigation measures which can be implemented to reduce emissions. Analysis of historic emissions allows us to identify key source sectors and mitigation measures can then be developed to target these sources. In Uganda, key source sectors of methane include agriculture, residential cooking, and waste. Key sources of black carbon include residential cooking, industrial energy use, and charcoal production (Section 2). Mitigation measures in these sectors should therefore be prioritized in Uganda. To understand how effective measures in these sectors are, we can quantify their emission reduction potential.

In order to quantify potential emission reductions, a baseline emission scenario was modelled, as well as a suite of different mitigation measures. The baseline scenario is a business-as-usual scenario which assumes no action is taken on SLCPs. Emissions are projected into the future using socio-economic variables such as population and GDP. The baseline scenario was developed using key national documents including the Uganda Vision 2040 (National Planning Authority, 2013) and the Uganda Energy Transition Plan (IEA, 2023) (see the Technical Annex for more details). This is used as a reference to which alternative future scenarios can be compared. Here, the baseline scenario is used as a reference for the mitigation scenario. In the mitigation scenario, a suite of mitigation measures targeting key source sectors was identified and modelled to quantify the emission reductions compared to the baseline scenario.

A list of policies and measures that could reduce SLCPs was identified based on national policies and advice from sectoral experts in the technical working group. This list of measures was then reviewed to identify measures for which the emission reduction could be quantified and targets were updated based on consultation with sectoral experts. Measures that provided a specific target and timeframe were included in the analysis. The final list of measures included in the analysis is presented in Table 3.1. When compared to the baseline scenario, the mitigation scenario allows for the potential emission reductions to be quantified and for measures to be prioritized. In the mitigation scenario, it is assumed that measures are fully implemented within the timeline defined and that the emission reductions are therefore fully achieved. Mitigation measures were modelled individually and in a combined scenario which assumed all measures are implemented simultaneously. All scenarios were projected to 2040 to reflect the Uganda Vision 2040 (National Planning Authority, 2013). Results are also shown for 2030 and 2035 as this aligns with the upcoming reporting requirements to the UNFCCC.

Table 3.1. Mitigation measures included in the SLCP analysis.

Sector	Measure ID	Measure Description	Details	Variable manipulated to model measure	Units of variable	2019	2024	Target			Source of mitigation measure
								2030	2040	2050	
Residential	Res_1	Efficient Stoves and Clean Cooking	Access to efficient cookstoves and cleaner fuels will increase	Proportion cooking with improved cookstoves	% of households	Urban: 0 Rural: 0		40	7	0	Energy Policy of Uganda (2023)/Energy Transition Plan (2023)
				Proportion cooking with LPG		Urban: 4.1 Rural: 0.3		34	42	26	
				Proportion cooking with electricity		Urban: 4.4 Rural: 1.2		16	36	54	
				Proportion cooking with biogas and bioethanol		Urban: 0.2 Rural: 0.1		10	15	20	
	Res_2	Energy Efficiency	75% reduction in energy use for lighting in 2030	Electricity used for lighting	kwh/household	80	70	20	20	20	NDC 2.0 (2022)
Energy	Energy_1	Distribution Losses	Strengthening electricity transmission and distribution infrastructure	Electricity distribution losses	% of grid electricity	18.4	17	10	10	9	Energy Policy of Uganda (2023)

		Transmission Losses		Electricity transmission losses		4.5	4	3	3		
	Energy_2	Efficient charcoal kilns	Increasing the efficiency of charcoal kilns	Proportion of kilns which are efficient	% of charcoal produced in efficient kilns	0	5	15	35	100	NDC 2.0 (2022)
	Ind_1	Industrial Energy Use	Increasing energy efficiency	Reduction in fuel use in industry	% reduction	0		10			NDC 2.0 (2022)
	Com_1	Commercial/Institutional Improved Efficiency	Improved efficiency of charcoal cookstoves in commercial and service sector	Proportion of efficient stoves	% of charcoal stoves	0		50			Adapted from NDC 2.0 (2022)
	Com_2	Commercial/Institutional Cleaner Fuels	Switching to cleaner stoves	Wood stoves switched to LPG	% of wood stoves	0	2	11.9	30	49	NDC 2.0 (2022)
				Wood stoves switched to electricity		0	2	7.81	18	28	
Transport	Tran_1	Non-Motorised Transport	Development of non-motorized transport infrastructure	Proportion of passenger-km travelled by walking	% of passenger-km	50	50	60			NDC 2.0 (2022)

			Proportion of passenger-km travelled by cycling		0.5	0.5	2			
Tran_3	Fuel Efficiency	Improve fuel economy (20% by 2030, 35% by 2040)	Gasoline consumption	litres/km	11.8	11.8	9.4	7.7		NDC 2.0 (2022)
			Diesel consumption		13.4	13.4	10.7	8.7		
Tran_4	Electric Vehicles	Uganda fully transitioned to e-Mobility in public transport and motorcycles by 2030 and passenger vehicle sales by 2040	Proportion of passenger-km taken by electric buses	% of bus passenger-km	0	0	10	20	20	Uganda's National E-Mobility Strategy (2023)
			Proportion of passenger-km taken by electric minibuses	% of minibus passenger-km	0	0	5	5	5	
			Proportion of passenger-km taken by electric motorcycles	% of motorcycle passenger-km	0	0.8	20	60	90	
			Proportion of passenger-km taken by electric passenger cars	% of car passenger-km	0	0		10		
Tran_5	Euro IV	By 2030 all newly registered HDVs in Uganda are Euro IV compliant	Proportion of tonne-km taken by Euro IV trucks	% of HDV tonne-km	0		7	57		New Measure

	Tran_6	Euro VI	By 2040 all newly registered HDVs in Uganda are Euro VI compliant	Proportion of tonne-km taken by Euro VI trucks	% of HDV tonne-km	0			7	New Measure
	Tran_7	Rail fuel economy	22% improvement of diesel locomotives achieved in 2030 relative to 2015.	Diesel consumption from rail	ktoe	36	46	54		NDC 2.0 (2022)
Waste	Waste_1	Waste collection	Efficiency of solid waste collection	Urban waste collection rate	% of solid waste collected	60		70		NDC 2.0 (2022)
				Rural waste collection rate		0.4		70		
	Waste_2	Sewage service coverage	Increase to sanitation and wastewater treatment infrastructure and services through increased coverage of sewage services	Proportion of wastewater going to anaerobic deep lagoons	% of urban wastewater	9.5		31		NDC 2.0 (2022)
					% of rural wastewater	0.04		31		
	Waste_3	Methane capture at landfill	Assumed all landfills are fitted with methane capture technology.	Proportion of methane emitted from landfill sites that is captured	% of methane at anaerobic landfills	0		50	75	Additional measure
					% of methane at unmanaged shallow landfills	0		7	10	

	Waste_4	Methane capture at wastewater treatment plants	Methane will be captured at centralised anaerobic wastewater treatment plants	Proportion of waste in anaerobic digesters	% of wastewater (urban and rural waste))	0	25	31		Additional measure
Agriculture	Ag_1	Animal productivity	Production per animal of meat and dairy will increase to achieve the same production with a smaller herd size.	Carcass weight cattle	kg/animal	156	160		191	Additional measure
				Carcass weight sheep and goats		12	13		15	
				Carcass weight pigs		62	63		69	
				Carcass weight poultry		1.3	1.4		1.5	
				Milk yield	kg/animal/year	438	450		573	
HFCs	Ind_2	HFC Phase Down	Compared to the 2020-2022 average, a 10% reduction in consumption of HFCs by 2029, a 30% reduction by 2035, and a 50% reduction by 2040	HFC imports	tonnes/year	101	106	59		Kigali Amendment (UNEP, 2019)

3.1. Baseline Scenario

If no action is taken to reduce SLCPs (i.e. the baseline scenario), then emissions of methane and black carbon are projected to increase by 69% and 135% respectively by 2035, i.e. by 2035 emissions of black carbon could more than double compared to 2019. Taking this further to 2040, emissions of methane are projected to increase by 95% while black carbon is projected to increase by 216%, or a 3-fold increase (Figure 3.2). In the baseline scenario, energy demand is projected to grow with GDP, resulting in an increase in emissions from energy consumption, particularly in the industry and commercial and service sectors. Furthermore, there is a subsequent growth in charcoal production to meet the demand for charcoal consumption. The waste sector was projected to grow with population size, assuming waste generation per capita remains constant. As a result, methane from the waste sector grows by 218% by 2040.

In the baseline scenario, it was assumed that the oil production and refining begin in Uganda following extraction from the Lake Albert basin and refining in the Hoima refinery. Following Uganda's Energy Transition Plan (IEA, 2023), it was assumed that oil production peaks at 250 thousand barrels per day in 2030 and then declines by 6% annually to 2050. The Hoima refinery is projected to have a capacity of 60 thousand barrels per day by 2028 (IEA, 2023). There is therefore increasing emissions associated with these processes and in 2040 there is an estimated 9 thousand tonnes of methane and 380 thousand tonnes of CO_2. This is a relatively small source compared to other sources (oil production and refining fall under 'other' in Figure 3.2).

In the baseline scenario, it was assumed that meat consumption per person stays consistent. This is likely to be a conservative assumption given the historic trends and dietary trends in other countries (FAO, 2019). The small increase in agricultural emissions between 2019 and 2020 is from enteric fermentation. The FAO data used to estimate cattle numbers (see Technical Annex) shows a reduction in offtake rate in 2020, which ultimately results in increasing animal numbers and hence emissions.

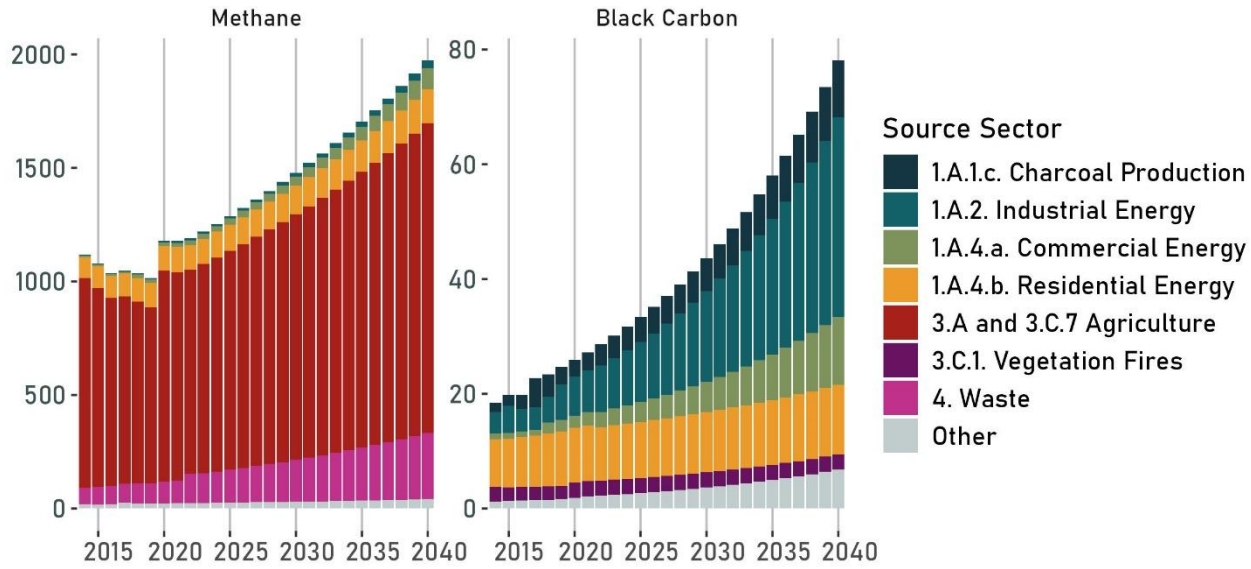


Figure 3.2. If no action is taken, then emissions of methane and black carbon are projected to increase substantially. Emissions of methane and black carbon in the baseline scenario. Colours denote emission sources.

3.2. Mitigation Scenario

Despite the projected increase in emission in the baseline scenario, substantial emission reductions could be achieved in Uganda if SLCP action is taken. If all measures outlined in Table 3.1 are implemented, emissions of methane and black carbon could be reduced by 17% and 33% by 2035. By 2040, reductions in methane could reach 22% while black carbon could be reduced by 36% compared to the baseline (Figure 3.3).

The greatest reductions in both methane and black carbon are achieved through efficient stoves and clean cooking in the residential sector (measure Res_1) (Table 3.2). Implementing this measure alone can reduce total methane and black carbon emissions by 8% and 21% by 2040. Methane capture at landfill and increased animal productivity also make substantial contributions to methane mitigation. Assuming a capture efficiency of 75% for anaerobic landfills and 10% efficiency for shallow dumps, 26% reduction in total emissions of methane from waste, or a 4% reduction in total methane could be achieved. Increasing animal productivity reduces methane from enteric fermentation by 8% and methane from manure management by 6%. This equates to a 5% reduction in total methane emissions in Uganda. For black carbon, cleaner fuels in the commercial sector are the second most effective measure to reduce emissions, achieving a 5% reduction in 2040 compared to the baseline. Efficient stoves in the commercial sector and industrial energy efficiency also have a substantial black carbon reduction of 4% and 5% respectively. All these measures contribute to reduced black carbon through the reduction of biomass burning.

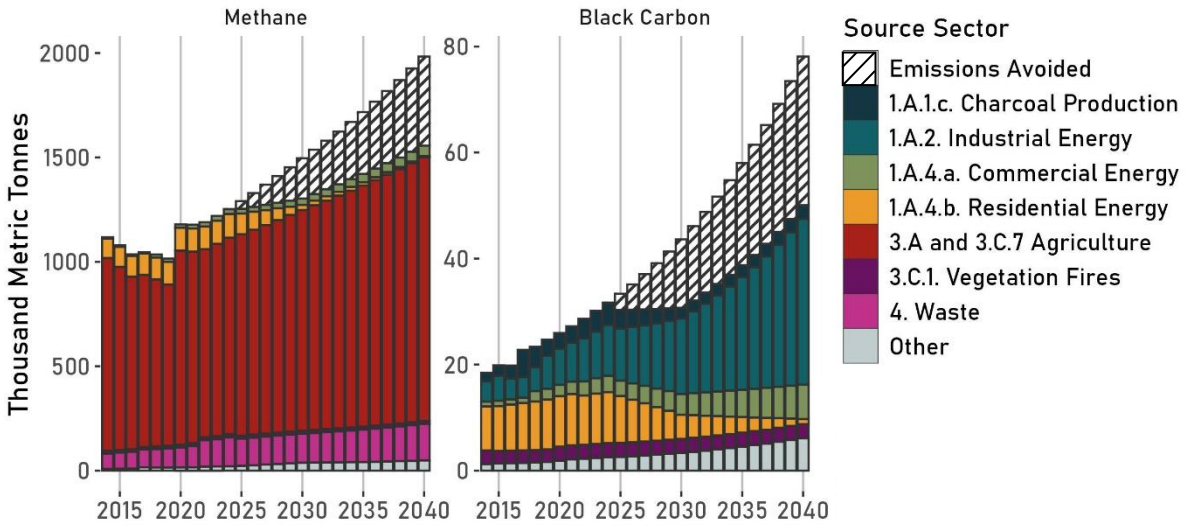


Figure 3.3. Reduction in methane (left) and black carbon (right) emissions in Uganda if all SLCP measures are implemented. Emissions are shown for years from 2019 to 2040 under the mitigation scenario. Colour denotes emission source sectors and dashed bars represent the emission reduction potential of the mitigation scenario compared to the baseline scenario. For each pollutant, only the largest four emission sources are shown, the remaining sources are summed under 'all others.'

Table 3.2. Emission reductions achieved by each mitigation measure modelled. Emission change is show as a percent reduction from the baseline value. A negative change indicates an increase in emissions.

Sector	Measure		Emission change compared to baseline (%)			
			Methane		Black Carbon	
		Measure ID	2035	2040	2035	2040
Residential Energy	Efficient Stoves and Clean Cooking	Res_1	7.70	8.00	21.4	21.3
	Energy Efficiency	Res_2	-	-	-	-
Energy Industries	Transmission and distribution losses	Energy_1	-	-	-	-
	Efficient charcoal kilns	Energy_2	0.04	0.06	0.46	0.64
Industrial Energy Use	Industrial Energy use	Ind_1	0.16	0.20	4.31	4.72
Commercial/ Institutional Energy Use	Efficient Charcoal Stoves	Com_1	0.54	0.70	3.24	3.60

	Cleaner Fuels	Com_2	0.86	1.58	3.33	5.23
Transport	Non-Motorised Transport	Tran_1	0.01	0.01	0.14	0.14
	Fuel Efficiency	Tran_3	0.02	0.02	-	-
	Electric Vehicles	Tran_4	0.01	0.02	0.20	0.24
	Euro IV	Tran_5	-	-	0.12	0.21
	Euro VI	Tran_6	-	-	-	0.03
	Rail fuel economy	Tran_7	0.00	0.00	0.02	0.02
Waste	Waste collection	Waste_1	- 5.25	- 6.23	0.32	0.25
	Sewage service coverage	Waste_2	- 4.86	- 4.61	-	-
	Methane capture at landfill	Waste_3	2.61	3.84	-	-
	Wastewater Methane Capture	Waste_4	1.80	1.95	-	-
Agriculture	Animal productivity	Ag_1	3.52	5.12	-	-
IPPU	HFC Phase Out	Ind_2	-	-	-	-
All	NDC+ Measures	NDC+	- 0.81	- 0.30	33.10	35.68
	All Measures	**All**	**17**	**22**	**33**	**36**

Uganda's 2022 NDC includes measures to increase solid waste collection and sewage services. Based on the existing infrastructure in Uganda, it was assumed that the additional waste that is collected is managed in anaerobic and shallow landfills (solid waste) and anaerobic lagoons (liquid waste). Consequently, if these measures are implemented without methane capture, then we will see an increase in emissions (measures Waste_1 and Waste_2 Table 3.2). This emission increase is also reflected in the NDC+ Measures combined scenario. To counter this increase, we modelled 2 additional waste measures in which landfill sites are fitted with methane capture technology and methane in anaerobic lagoons is collected in anaerobic digesters. If these technologies are implemented, then we see a reduction in methane emissions compared to the baseline (measures Waste_3 and Waste_4 Table 3.2).

To reflect Uganda's commitment to the Kigali Amendment, HFC phase-down was modelled. The phase down program prescribes a 10% reduction in consumption of HFCs by 2029, and a 50% reduction by 2040. As they are the main consumer, refrigeration and air conditioning units will require the greatest efforts to substitute for less damaging substances. This reduction trajectory is shown in Figure 3.4.

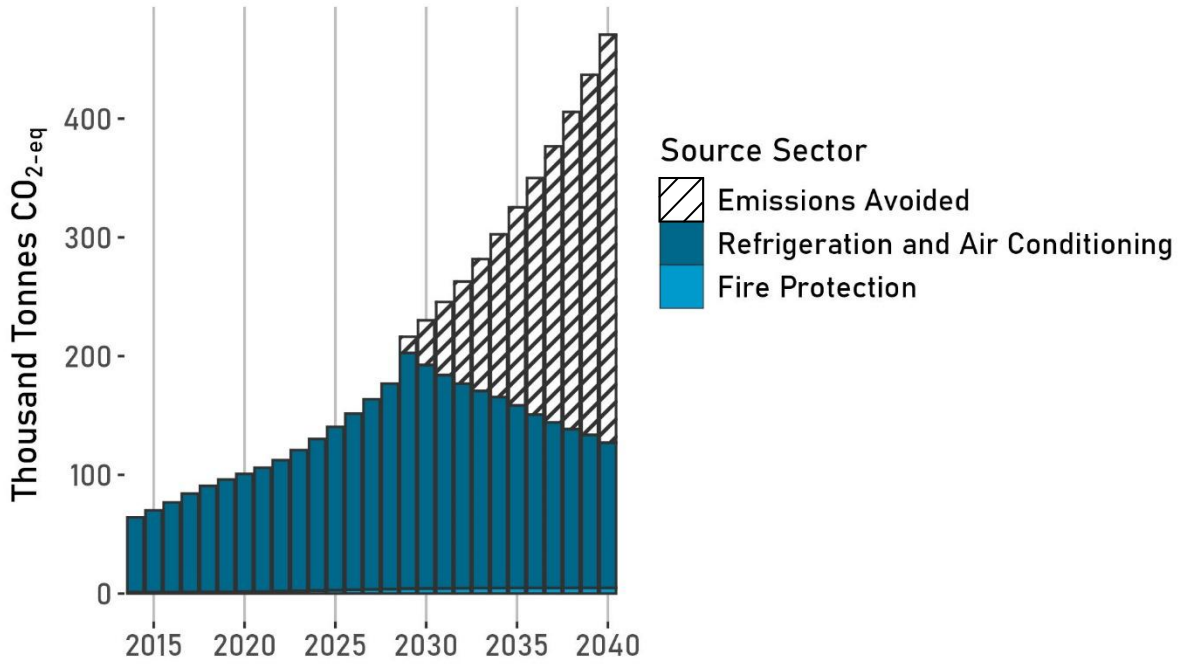


Figure 3.4. Potential emission reductions of HFCs if the Kigali Amendment is implemented in Uganda.

There were some measures which were not included in the analysis that could reduce emissions further. For example, in the transport sector, additional mass transport measures were highlighted as important measures in the sector but not included in the LEAP analysis. Additional measures included increasing infrastructure for public transport, cycle lanes, freight railways, and the development of the Bukasa shipping port on Lake Victoria. These measures could reduce emissions through shifting distance travelled from cars and trucks to low-emission transport modes. However, it was not possible to quantify the emission reductions of these measures as it could not be determined how many passenger-km or vehicle-km these measures would displace. The Petroleum Authority of Uganda plans to mitigate emissions through LPG recovery from oil-associated gas, energy efficiency optimizations (e.g., waste heat recovery from gas turbines), electrification of some facilities using grid-based hydro-power, and solar farms for project heat/power needs. Based on these measures, the Energy Transition Plan targets a methane reduction of ~0.3 thousand tonnes per million Barrels of Oil Equivalent (IEA, 2023). At its peak in 2030, the oil and gas sector contributes less than 2% of methane emissions in Uganda (Table 2.1) but these emissions could be reduced further if the planned measures are fully implemented.

Implementing SLCP actions can also bring about co-benefits through reducing other pollutants. Implementing SLCP measures can contribute to national commitments to reduce CO_2. Under the baseline scenario, emissions of CO_2 are projected to increase by 247% and 386% by 2035 and 2040, respectively. Under the SLCP mitigation scenario where all measures are implemented, emissions of CO_2 are reduced by 9% in 2040 (Table 3.3). Introducing electric vehicles, not only reduces SLCPs and air pollutants, but reduces CO_2 emissions by 4% in 2040. This is an effective

measure because the majority of Uganda's electricity supply is generated through renewable sources, primarily hydropower. Increasing industrial energy efficiency also reaps benefits for climate reductions, with a 2.3% reduction in total CO_2 emissions by 2040. There is also the potential for trade-offs between emissions. For example, the increased use of LPG increases CO_2 emissions as it is replacing biomass, which is considered carbon neutral. However, the use of LPG reduces methane emissions, and reduces nitrous oxide emissions by 8% by 2040 (Table 3.3).

Furthermore, emissions of other ozone precursors such as nitrogen oxides, organic carbon, carbon monoxide, non-methane volatile organic carbons, and ammonia can be reduced by between 10-71% by 2040. Clean cooking has substantially the biggest mitigation potential for organic carbon, carbon monoxide, ammonia, and both $PM_{2.5}$ and PM_{10}. Efficient charcoal stoves in the commercial sector and efficient charcoal kilns also help to mitigate these pollutants while energy efficient in industry reduces emissions of particulate matter, sulphur dioxide, and nitrogen oxides. Increased livestock productivity reduces nitrous oxide and ammonia through reduced manure production. Fine particulate matter ($PM_{2.5}$) could be halved by 2040 which could result in significant benefits to human health in Uganda (see Section 3.3). This demonstrates the synergies and opportunities for co-benefits of acting on SLCPs, greenhouse gases, and other air pollutants.

3.3. Priority mitigation measures

Of the 19 SLCP actions in the SLCP Plan, 4 can be identified as priority measures due to their substantial emission reduction potential. These 4 priority measures are:

1. 100% of households have access to either clean fuels or efficient stoves by 2040.
2. 70% of solid waste is collected and managed in landfills with methane capture by 2040.
3. Increase livestock productivity and reduce methane emission intensity by 2050.
4. HFCs phased out in line with the Kigali Amendment.

Implementing these 4 measures alone could reduce emissions of methane, black carbon, and HFCs by 14%, 22%, and 54% respectively by 2035 (Table 3.4). If the 4 priority measures are implemented in isolation, then there could be a trade-off in pollutants. For example, increasing use of LPG for cooking leads to a small increase in fossil CO_2 emissions. SLCP priority actions therefore need to be implemented alongside actions to reduce CO_2.

Table 3.3. Summary of emission reductions possible through implementing all 19 mitigation measures compared to the baseline scenario in years 2030, 2035, and 2040. NMVOCs = Non-Methane Volatile Organic Compounds.

Year	Scenario	Units	Methane	Black Carbon	HFCs*	CO_2	Nitrous Oxide	Organic Carbon	$PM_{2.5}$	PM_{10}	Ammonia	Sulphur Dioxide	Nitrogen Oxides	Carbon Monoxide	NMVOCs
2019	Baseline	Thousand Metric Tonnes	1,016	25	96	5,740	16	105	211	228	235	7	169	4,033	1,835
2030	Baseline	Thousand Metric Tonnes	1,496	44	230	14,186	23	157	352	373	330	12	273	6,241	3,478
	All Measures		1,302	31	173	13,385	21	120	269	313	302	11	215	2,376	3,104
	Reduction compared to baseline	%	13	30	25	6	9	24	24	16	8	9	24	62	34
2035	Baseline	Thousand Metric Tonnes	1,717	58	325	19,895	27	193	418	439	374	15	341	7,670	4,686
	All Measures		1,420	39	150	18,438	26	120	259	295	333	14	260	2,528	4,272
	Reduction compared to baseline	%	17	33	54	7	11	38	38	33	11	10	26	67	34
2040	Baseline	Thousand Metric Tonnes	1,983	78	471	27,873	31	242	512	535	424	20	434	9,521	6,360
	All Measures		1,556	50	123	25,447	28	123	258	284	366	18	319	2,722	4,272
	Reduction compared to baseline	%	22	36	74	9	14	49	50	47	14	11	27	71	33

*HFCs are reported in thousand metric tonnes of CO_2-equivalents.

Table 3.4. Summary of emission reductions possible through implementing 4 priority mitigation measures compared to the baseline scenario in years 2030, 2035, and 2040. NMVOCs = Non-Methane Volatile Organic Compounds.

Year	Scenario	Units	Methane	Black Carbon	HFCs*	CO_2	Nitrous Oxide	Organic Carbon	$PM_{2.5}$	PM_{10}	Ammonia	Sulphur Dioxide	Nitrogen Oxides	Carbon Monoxide	NMVOCs
2019	Baseline	Thousand Metric Tonnes	1,016	25	96	5,740	16	105	211	228	235	7	169	4,033	1,835
2030	Baseline	Thousand Metric Tonnes	1,496	44	230	14,186	23	157	352	373	330	12	273	6,241	3,478
	Priority Measures		1,341	35	173	15,197	22	131	291	334	305	11	224	2,867	2,458
	Reduction compared to baseline	%	10	21	25	-7	7	17	18	10	8	1	18	54	29
2035	Baseline	Thousand Metric Tonnes	1,717	58	325	19,895	27	193	418	439	374	15	341	7,670	4,686
	Priority Measures		1,479	45	150	21,183	24	138	295	331	338	15	282	3,309	3,381
	Reduction compared to baseline	%	14	22	54	-6	9	29	29	25	10	-1	17	57	28
2040	Baseline	Thousand Metric Tonnes	1,983	78	471	27,873	31	242	512	535	424	20	434	9,521	6,360
	Priority Measures		1,645	61	123	29,496	28	152	315	342	375	20	362	3,932	4,704
	Reduction compared to baseline	%	17	21	74	-6	10	37	38	36	12	-1	17	59	26

*HFCs are reported in thousand metric tonnes of CO_2-equivalents.

3.4. Health impacts of SLCP actions

To understand the health impacts of SLCPs and air pollution in Uganda, a health impact assessment was undertaken. The assessment quantifies the number of premature deaths associated with air pollutant emissions (including black carbon). Premature mortality was quantified in historic years as well as in the baseline and mitigation scenarios. This allows the health benefits of taking SLCP action to be quantified. The LEAP-IBC tool was used to do the health impact assessment following the methodology detailed in Kuylenstierna et al. (2020). The health endpoint for which the impact of ambient (i.e. outdoor) $PM_{2.5}$ exposure is estimated is premature mortality. Premature mortality was estimates using baseline mortality rates for each disease category from the Global Burden of Disease Results tool (IHME, 2025) and population from the National 2014 and 2024 censuses (Uganda Bureau of Statistics, 2014; Uganda Bureau of Statistics, 2024a). The methodological approach is described in more detail in the Technical Annex of this Plan.

In 2019 population-weighted annual $PM_{2.5}$ concentrations in ambient air were estimated to be ~20 μg m^3 in Uganda (Figure 3.5), almost four times the World Health Organization international air quality guideline value (5 μg m^3). As shown in Figure 3.5, a large fraction of this $PM_{2.5}$ concentration is estimated to result from emissions in other countries that is transported to Uganda, with 37% of $PM_{2.5}$ exposure estimated to result from national emissions emitted in Uganda. This total exposure to $PM_{2.5}$ concentrations was estimated to result in 3,949 premature deaths in 2019 (Figure 3.6), primarily affecting older people, with also resulting in ~885 infant deaths in 2019, 22% of the total number of premature deaths. In the baseline projection, both annual $PM_{2.5}$ exposure, and premature deaths were estimated to increase in 2040 compared to 2019 levels, with an annual exposure of 26 μg m^3 in 2040 in the baseline scenario, a 30% increase compared to 2019 levels (Table 3.5). Premature deaths were projected to increase to 10,472 per year in 2040, more than doubling 2019 levels. The larger relative increase in health burden from air pollution exposure compared to the increase in $PM_{2.5}$ concentrations is due to the larger, and older population exposed to air pollution in 2040 compared to 2019 levels.

The full implementation of Uganda's SLCP Plan was estimated to reduce population-weighted $PM_{2.5}$ concentrations by 5.6 μg m^3 in 2040 compared to the baseline scenario, a 22% reduction in total population-weighted $PM_{2.5}$ concentrations in 2040 compared to the baseline scenario (Figure 3.7 and Table 3.5). This reduction is also a 47% reduction in the contribution of Uganda's emissions to $PM_{2.5}$ concentrations in Uganda. This reduction in $PM_{2.5}$ concentrations across Uganda would avoid 1,175 premature deaths per year by 2040 (Figure 3.8), 11% of the total health burden from air pollution, and 40% of the health burden caused by emissions from Uganda itself. This only accounts for premature deaths associated with ambient air pollution. Premature deaths avoided would be substantially higher if health impacts from household air pollution were included. If only the 4 priority measures are implemented, 476 premature deaths per year could be avoided by 2035. This increases to 842 premature deaths a year by 2040.

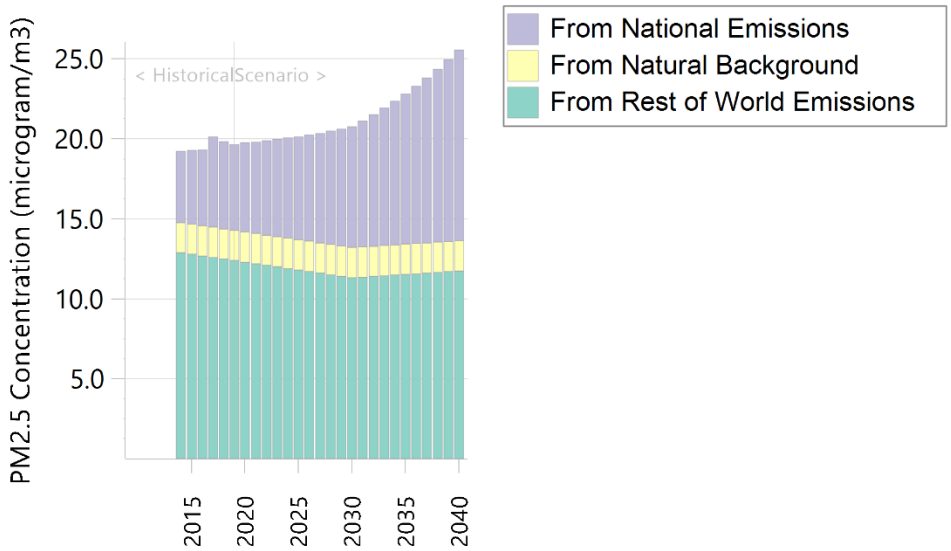


Figure 3.5. Population-weighted PM2.5 concentrations for Uganda from LEAP-IBC for 2014-2040 under the baseline scenario.

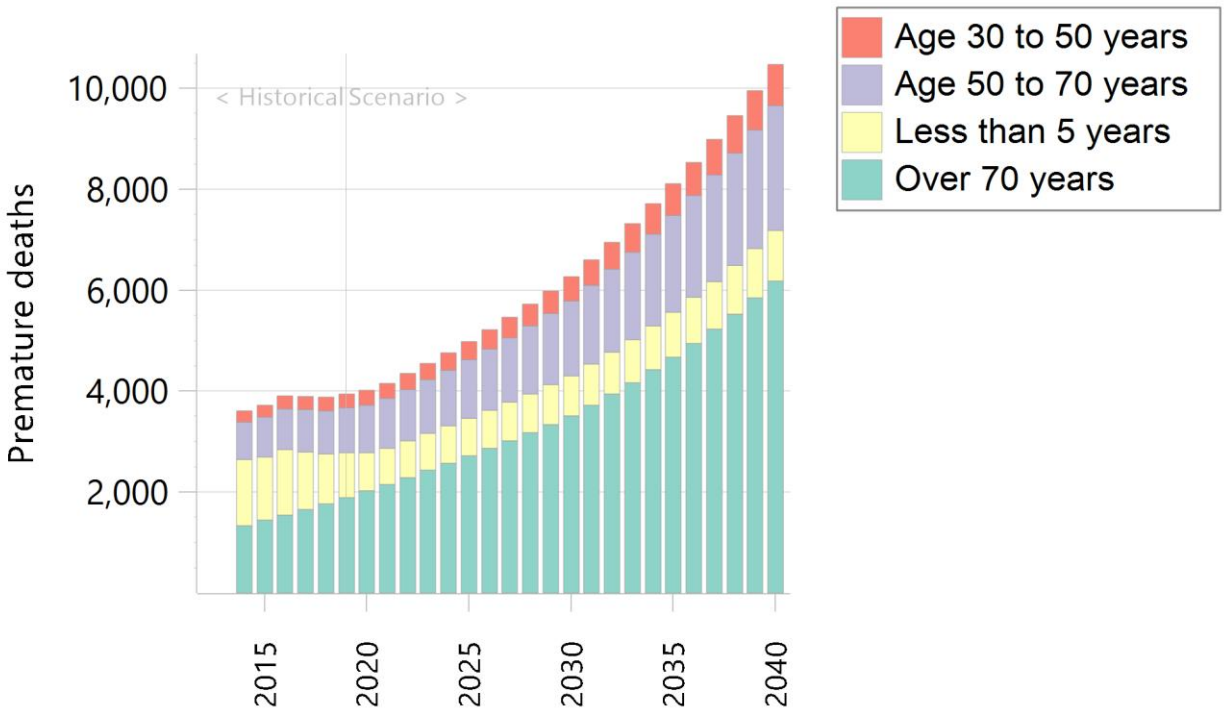


Figure 3.6. Premature deaths attributable to ambient PM2.5 exposure in Uganda from LEAP-IBC for 2014-2040 under the baseline scenario.

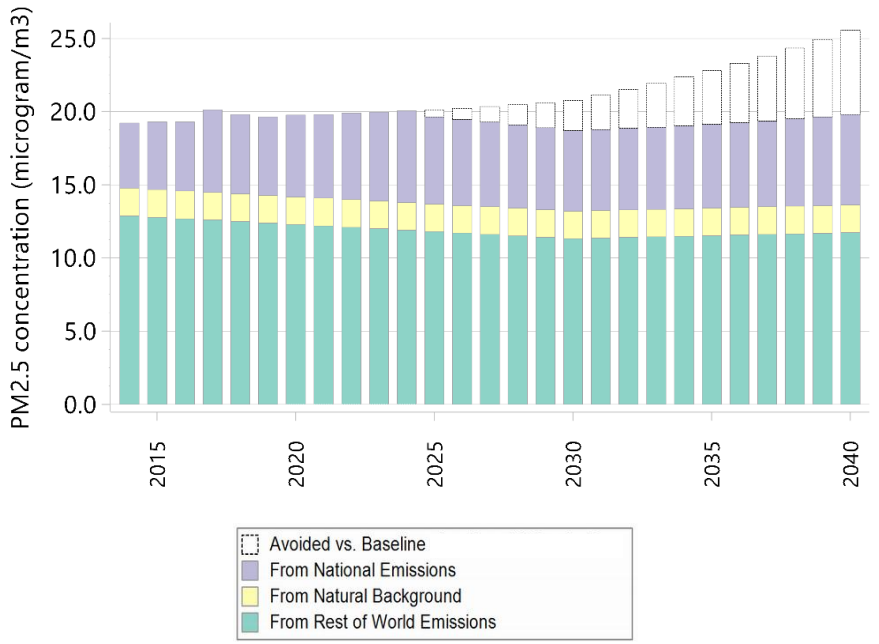


Figure 3.7. Reduction in population-weighted PM2.5 concentrations for Uganda from LEAP-IBC for 2014-2040 from the implementation of all measures included in Uganda's SLCP Plan, compared to the baseline scenario.

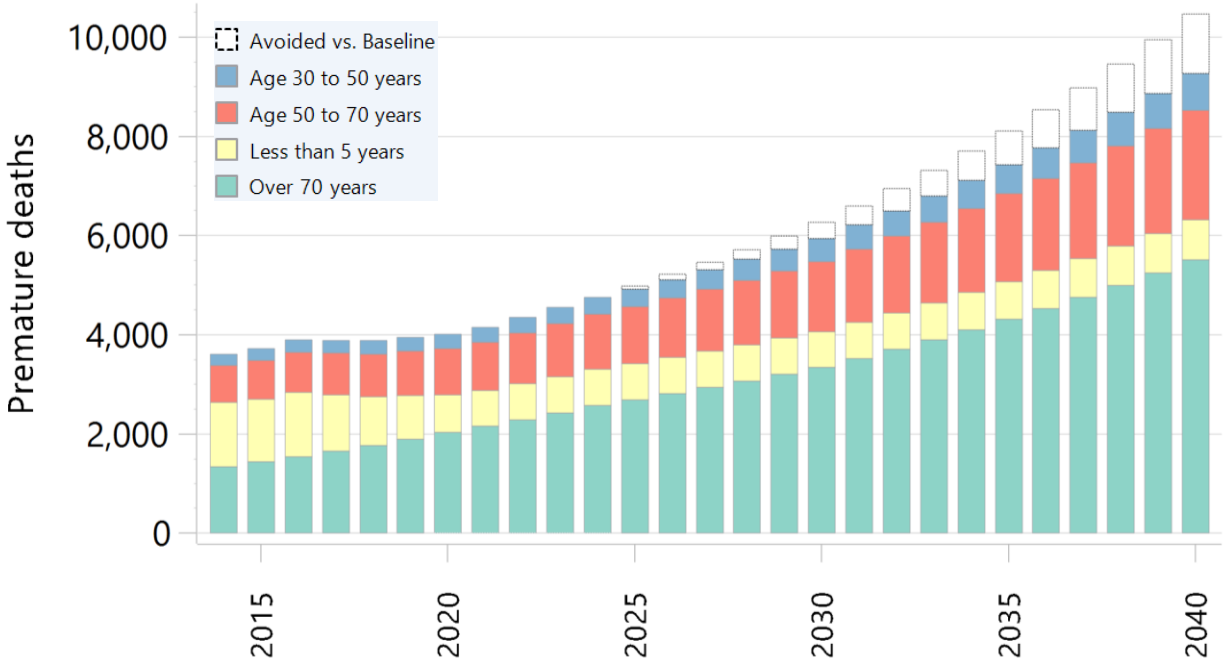


Figure 3.8. Premature deaths attributable to ambient PM2.5 exposure in Uganda from LEAP-IBC for 2014-2040 from the implementation of all measures included in Uganda's SLCP Plan, compared to the baseline scenario.

Table 3.5. Summary of $PM_{2.5}$ concentrations and health impacts in the baseline and SLCP Plan mitigation scenario if all 19 measures are implemented.

Metric	Units	Scenario	2019	2030	2035	2040
Population-weighted $PM_{2.5}$	$\mu g/m^3$	Baseline	19.6	20.7	22.8	25.6
		Mitigation	19.6	18.9	19.3	19.9
Premature deaths	People	Baseline	3,949	6,267	8,115	10,472
		Mitigation	3,949	5,976	7,469	9,298

4. Implementation pathways for Short-Lived Climate Pollutant measures

This Section presents a concrete set of actions that are required to achieve the full implementation of the policies and measures included in Section 3. Barries to successful implementation of each measure have been identified and outlined, and strategies/actions to overcome the same spelt out. Finally, for each of the actions, detailed implementation pathways have been identified.

Residential Sector

Res_1 - Efficient Stoves and Clean Cooking

Efficient stoves and clean cooking are sustainable mitigation measures against residential SLCP emissions, particularly black carbon. Implementing this measure will realize quantifiable climate and health co-benefits. In Uganda, this measure will mainly target increasing the number of households cooking with 1) improved cookstoves 2) LPG 3) electricity 4) biogas and bioethanol. Table 4.1 outlines the priority strategies and actions to achieve clean cooking in Uganda. The pathway to implementing the strategies and actions to achieve efficient biomass stoves and clean cooking is presented in Figure 4.1 below.

Table 4.1. Implementation strategies and actions: Efficient Stoves and Clean Cooking.

Sector	**Residential**
Measure	Efficient Stoves and Clean cooking
Targets	• Proportion of households cooking with improved cookstoves (40% in 2030; 7% in 2040; 0% in 2050) • Proportion of households cooking with LPG (34% in 2030; 42% in 2040; 26% in 2050) • Proportion of households cooking with electricity (16% in 2030; 36% in 2040; 54% in 2050) • Proportion cooking with biogas and bioethanol (10% in 2030; 15% in 2040; 20% in 2050)
Context, current relevant policies, plans and projects	• Energy Policy of Uganda (2023) • Energy Transition Plan (2023)
Major Barriers	• Lack of /weak implementation of standards for efficient stoves • Inadequate technical capacity for local production of efficient stoves • High cost of raw materials

	• Lack of incentives for production and import of efficient stoves • Low testing capacity for quality of efficient stoves • Inadequate distribution networks for efficient stoves • High retail price of efficient stoves • Low awareness on benefits of using efficient stoves • Inadequate LPG and bioethanol bulk transport & distribution network • Inadequate LPG and bioethanol bulk storage capacity • Low LPG bottling capacity • High cost of LPG at retail level • Low awareness on benefits of using LPG for cooking • Safety concerns about LPG
Primary Responsibility	Ministry of Energy and Mineral Development
Actions	• Establish/implement standards for efficient biomass stoves • Build technical capacity for local production of efficient biomass stoves • Encourage use of locally available materials • Provide incentives for local production of efficient biomass stoves • Enforce existing standards • Incentivize import of efficient biomass stoves • Strengthen national quality/efficiency testing capacity for improved biomass stoves • Certify private testing laboratories • Expand distribution networks through public private partnerships • Provide incentives to reduce retail prices • Education & awareness on benefits of using efficient biomass stoves • Establish nationwide bulk transport & distribution for LPG • Expand nationwide bulk storage capacity • Expand LPG bottling capacity and distribution to retailers • Provide incentives to reduce LPG retail prices • Education & awareness of the benefits of using LPG for cooking • Implement safety standards

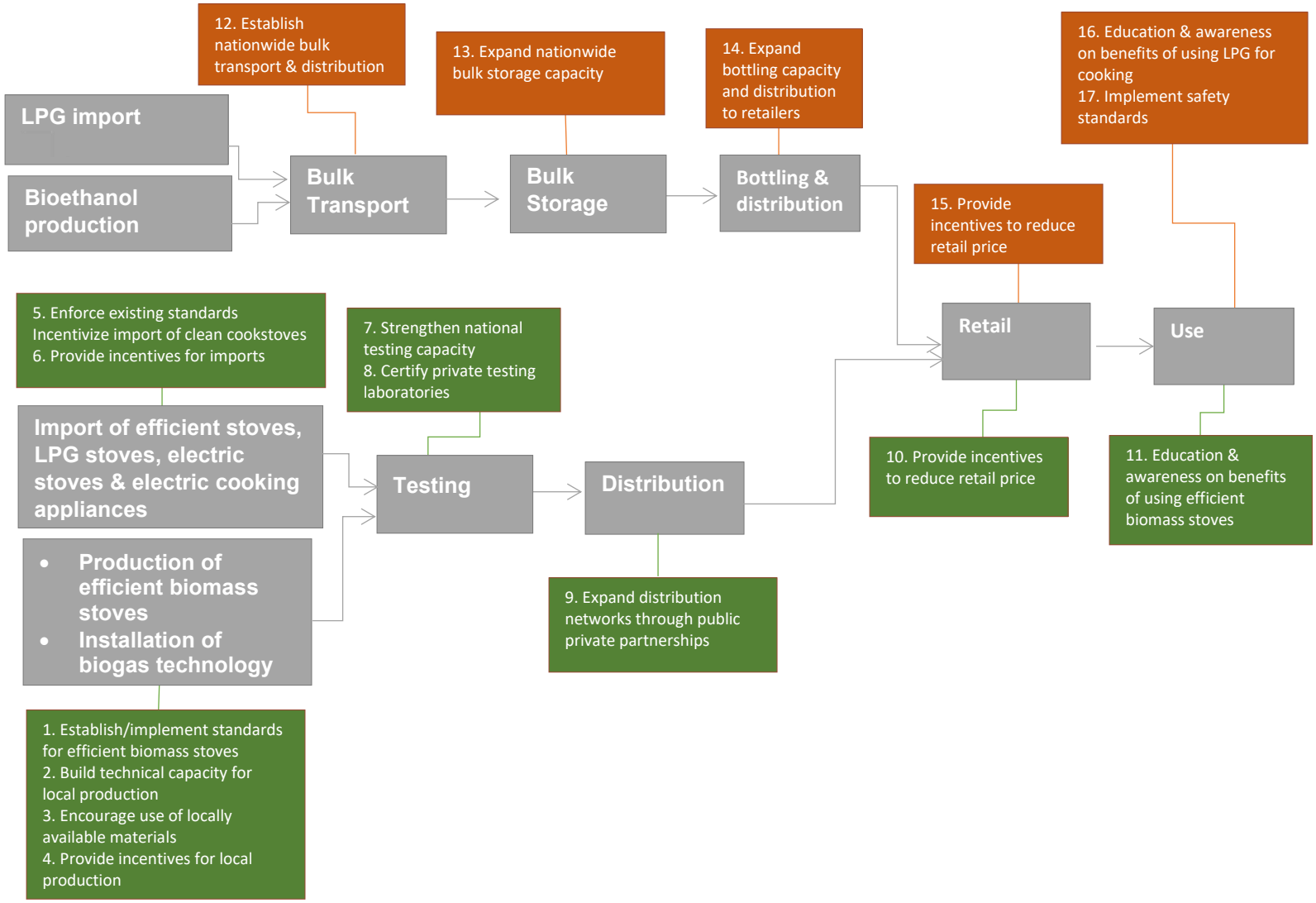


Figure 4.1. The implementation pathway for efficient biomass stoves and clean cooking.

Res_2 - Energy Efficiency

Improvements in the energy efficiency for lighting can significantly reduce overall electricity consumption and therefore reduce SLCP emissions from power generation. Table 4.2 presents the strategies and actions to achieve energy efficiency improvements in residential lighting. Figure 4.2 below lays out the implementation pathway for energy efficiency for lighting

Table 4.2. Implementation strategies and actions: Residential energy efficiency.

Sector	Energy
Measure	Energy efficiency
Target	75% reduction in energy use for lighting in 2030
Context, current relevant policies, plans and projects	NDC 2.0 (2022)
Major Barriers	• Inadequate policy frameworks to support energy efficiency • High capital costs of energy efficient technologies • Low public awareness about energy efficiency technologies and the benefits thereof
Primary Responsibility	Ministry of Energy & Mineral Development
Actions	• Put in place enabling policies, regulations, and energy performance standards to support energy efficiency programmes • Provide fiscal incentives e.g. subsidies, tax exemptions, etc. to promote adoption of energy efficiency technologies • Enhance public education and awareness on benefits of using energy efficient technologies • Awareness-raising campaigns to inform consumers about the benefits of energy-efficient systems and appliances and to encourage their acceptance and preference for more energy-efficient products

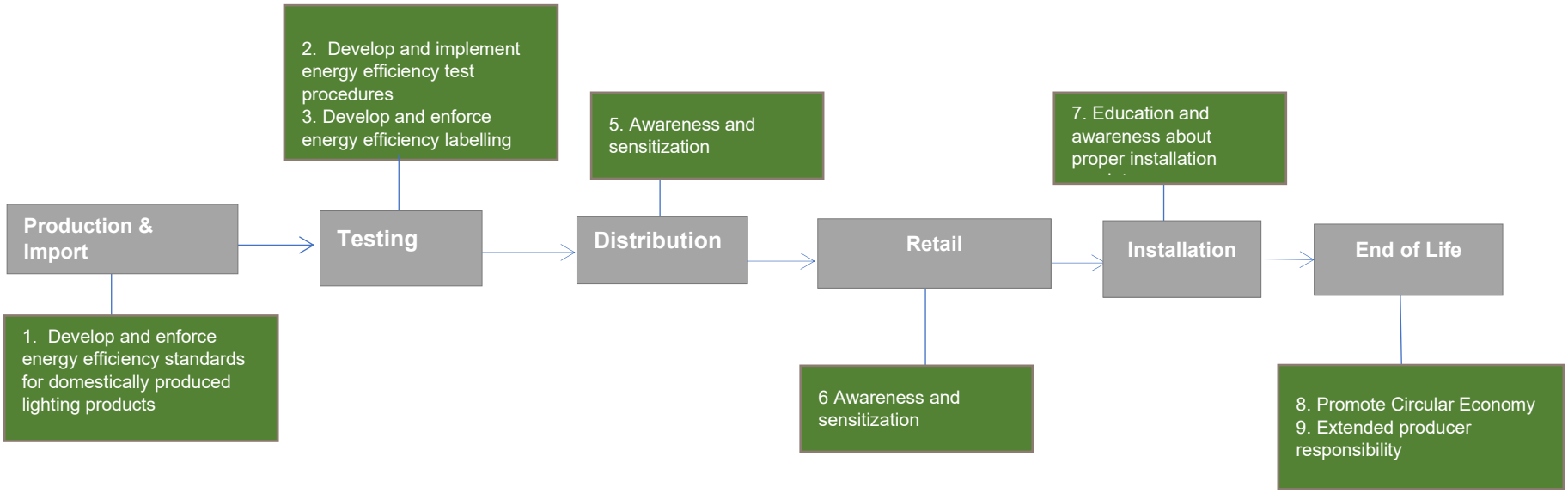


Figure 4.2. Implementation pathway: Residential energy efficiency improvements.

Energy Sector Implementation Pathways

Energy_1: Transmission and Distribution Losses

Electricity transmission and distribution systems include step-up transformers that connect power plants to the transmission system, transmission lines, sub-stations, primary voltage distribution lines, line or step-down transformers, and secondary lines that connect to individual homes and businesses. Electricity losses may occur at any of these stages in the system. Reducing line losses in the electrical transmission and distribution system presents a ready option to enhance efficiency and reduce generation-related emissions. Transmission efficiency gains can be achieved through investments in improved grid components and, on the demand side, in load management at peak levels. The strategies and actions reduce power transmission and distribution losses are presented in Table 4.3. Figure 4.3 shows the implementation pathway for reducing power transmission and distribution losses.

Table 4.3. Implementation strategies and actions: Transmission & distribution losses.

Sector	Energy
Measure	Reduce electricity transmission and distribution losses
Target	Reduce electricity transmission and distribution losses to 12.7 % in 2040
Context, current relevant policies, plans and projects	Energy Policy of Uganda (2023)
Major Barriers	• Old/obsolete power transmission and distribution infrastructure • High capital costs of new, efficient power transmission and distribution infrastructure
Primary Responsibility	Ministry of Energy & Mineral Development
Actions	• Environmental & Social Impact Assessment • Location identification • Consider existing infrastructure • Budget and financing • Raw materials • Environmental permits • Operation and maintenance • Upgrade existing infrastructure • Install smart systems • Operations and maintenance • Standards

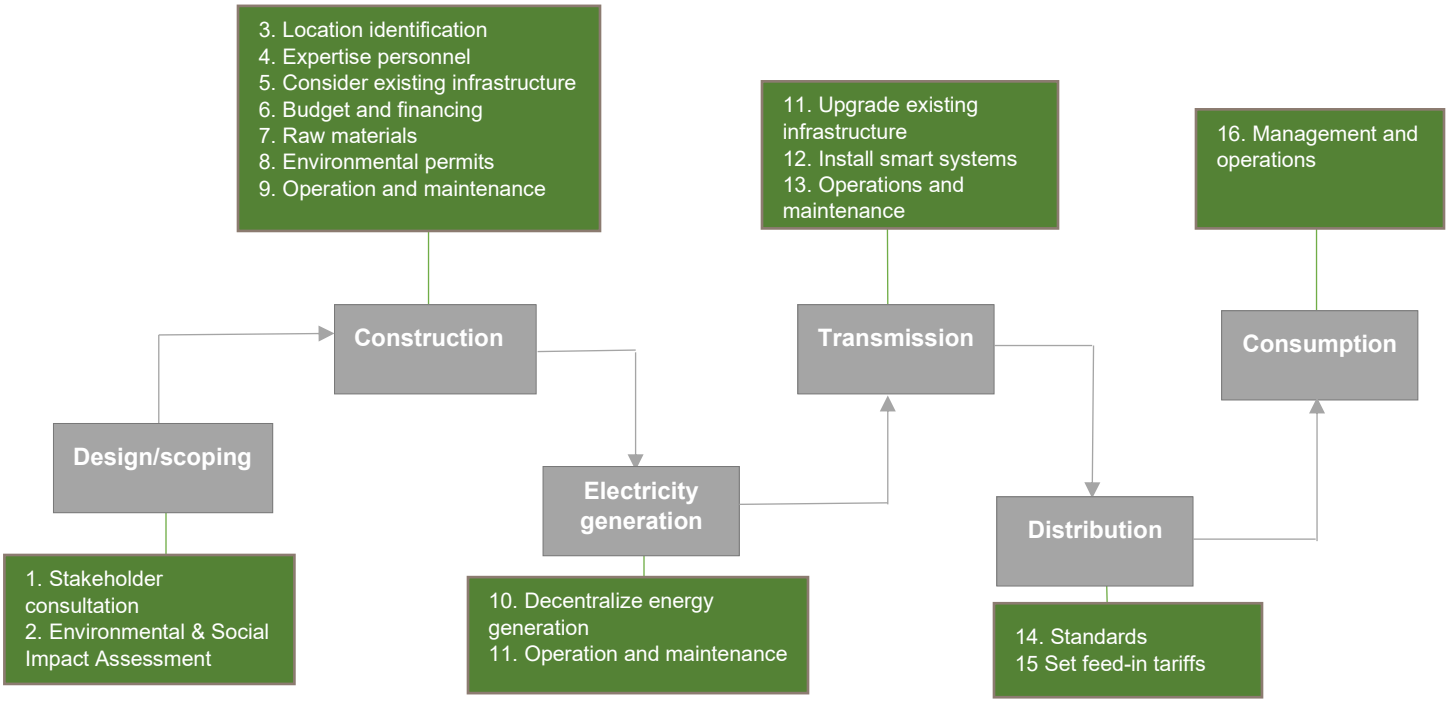


Figure 4.3. Implementation strategies and actions to reduce electricity transmission & distribution losses.

Energy_2: Efficient Charcoal Kilns

Improving the efficiency of charcoal kilns reduces the amount of fuel that is burnt to produce the same quantity of charcoal and thereby reducing emissions. Table 4.4 presents the implementation strategies and actions to achieve efficient charcoal kilns in Uganda. The implementation pathway for the strategies and actions to achieve efficient charcoal kilns is presented in Figure 4.4.

Tabe 4.4. Implementation strategies and actions: Efficient charcoal kilns.

Sector	Energy
Measure	Efficient charcoal kilns
Target	100% of charcoal produced in efficient kilns by 2030
Context, current relevant policies, plans and projects	NDC 2.0 (2022)
Major Barriers	• Low technical capacity for local production of efficient kilns • Lack of/non-enforcement of efficient charcoal kiln design & construction standards and regulations

	• Lack of incentives for local production of efficient charcoal kilns • High cost of construction materials • Finance local production/construction of efficient charcoal kilns • Environmental concerns • High retail cost of efficient kilns • Low awareness among charcoal producers on benefits of adopting efficient charcoal kilns
Primary Responsibility	Ministry of Industrialization
Actions	• Stakeholder consultation • Capacity building • Develop and enforce efficient charcoal kiln design & construction standards & regulations • Continuous R&D for efficient charcoal kiln design • Provide incentives for local production of efficient charcoal kilns • Promote use of locally available materials • Finance local production/construction of efficient charcoal kilns • Capacity building for local artisans • Environmental permits/licences • Provide fiscal incentives to reduce cost of efficient kilns • Education and awareness among charcoal producers to adopt efficient charcoal kilns • Provide subsidies for adoption/purchase of efficient charcoal kilns

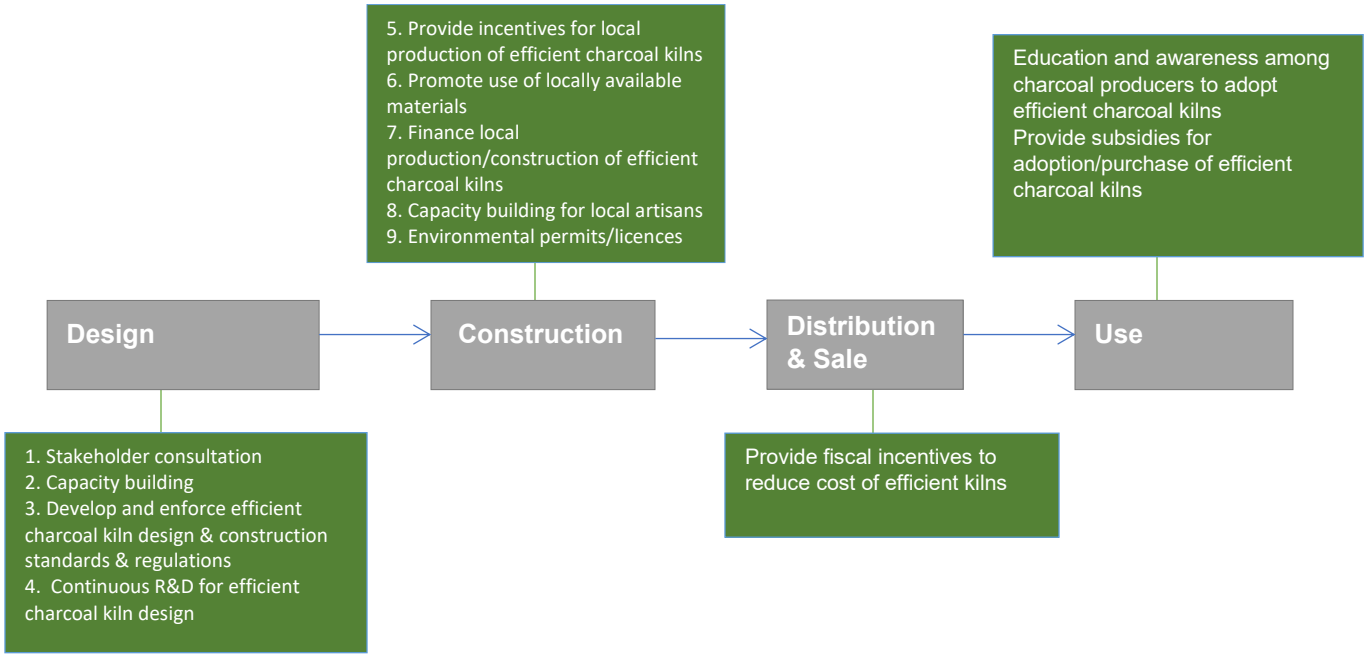


Figure 4.4. Implementation pathway: Efficient charcoal kilns.

Industrial Sector Implementation Pathways

Ind_1: Industrial Energy Use

Increasing the energy efficiency of industrial production processes can significantly reduce fuel usage hance reduce SLCP emissions. Table 4.5 presents the strategies and actions to achieve energy efficiency improvements in industrial production processes. Figure 4.5 lays out the implementation pathway for achieving energy efficiency improvements in industry.

Table 4.5. Implementation strategies and actions: Industrial Energy Use.

Sector	Energy
Measure	Industrial Energy Use
Target	10% reduction in fuel use in industry in 2030
Context, current relevant policies, plans and projects	NDC 2.0 (2022)
Major Barriers	• Inadequate policy frameworks to support energy efficiency • High capital costs of energy efficient technologies • Low public awareness about Energy Efficiency technologies and the benefits thereof
Primary Responsibility	Ministry of Energy & Mineral Development
Actions	• Put in place enabling policies/regulations/standards to support energy efficiency programmes

	• Provide fiscal incentives e.g. subsidies, tax exemptions, etc. to promote adoption of energy efficiency technologies • Enhance public education and awareness on benefits of using energy efficient technologies • Mandatory Minimum Energy Performance Standards (MEPS) and Test Methods • Awareness-raising campaigns to inform consumers about the benefits of energy-efficient appliances and to encourage their acceptance and preference for more energy-efficient products • Capacity-building for implementing agencies

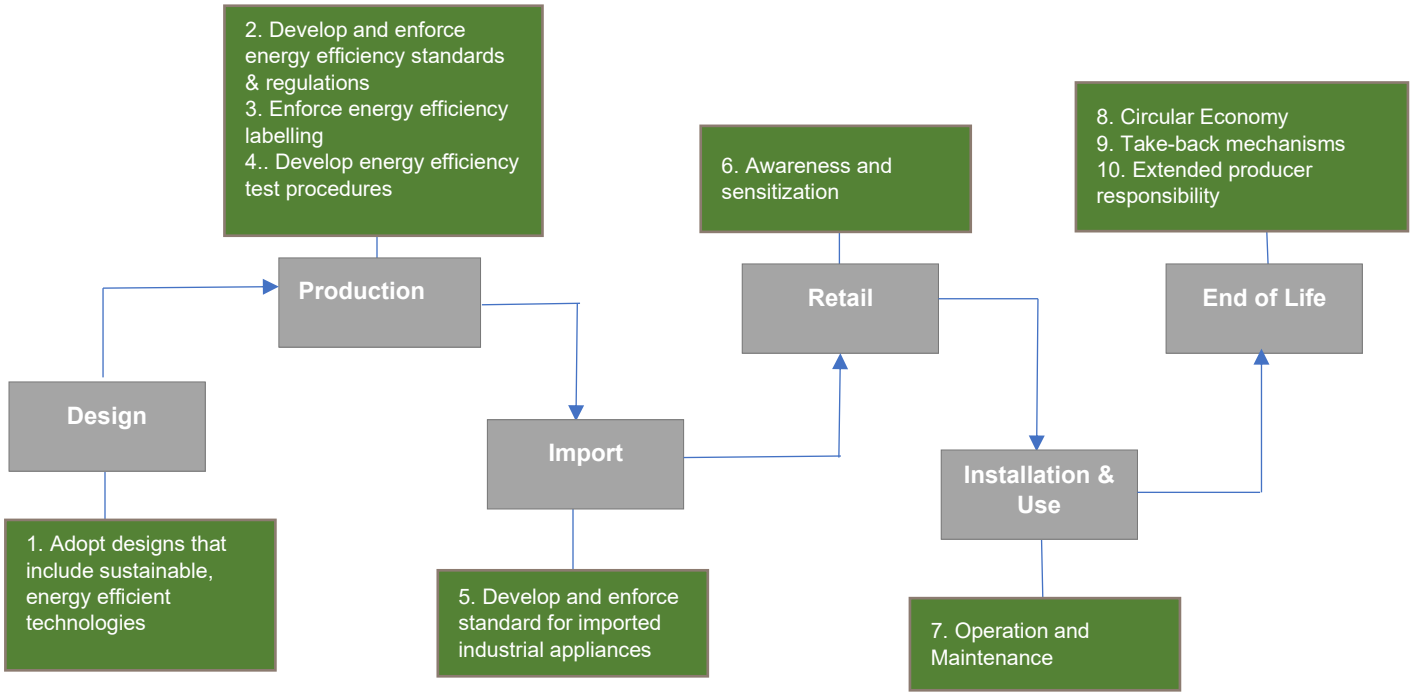


Figure 4.5. Implementation pathway for energy efficiency improvements in industry.

Ind_2: HFC Phase Out

The Kigali Amendment of the Montreal Protocol on Substances that Deplete the Ozone Layer was adopted by 197 Parties, including Uganda, at the Twenty-Eighth Meeting of the Parties in Kigali, Rwanda on 15 October 2016. The Kigali Amendment aims at phasing down hydrofluorocarbons (HFCs), which are frequently used as substitutes for Ozone-Depleting Substances (ODS), mainly in Refrigeration and Air-Conditioning (RAC). Although HFCs only have a small effect on ozone depletion, some are potent greenhouse gases. Uganda ratified the Kigali Amendment in June 2018 and is putting in place enabling strategy for quick adoption of low GWP HFC alternative technologies and the phase-down process of HFCs. Table 4.6 presents the strategies and actions for

implementation of Kigali Amendment to reduce HFC emissions in Uganda. Figure 4.6 shows the implementation pathway for the strategies and actions for implementation HFC Phase Out in Uganda.

Table 4.6. Implementation strategies and actions: HFC Phase Out.

Sector	Industry/industrial processes
Measure	HFC Phase Out
Target	Compared to the 2020-2022 average, a 10% reduction in consumption of HFCs by 2029, a 10% reduction by 2035, and a 50% reduction by 2040.
Context, current relevant policies, plans and projects	Kigali Amendment HFC phasedown schedule for Article 5 countries (UNEP, 2019)
Major Barriers	• Lack of policy & legal frameworks for implementation of Kigali Amendment • Lack of safe, low-GWP alternatives to HFCs • Low technical capacity on good RAC practices and technology conversion • Inefficient RAC systems
Primary Responsibility	National Environment Management Authority
Actions	• Ratify Kigali Amendment • Amend ODS regulations to include HFCs • Provide incentives for importation, commercialization & adoption of climate-friendly alternatives to high GWP HFCs • Train service technicians on implementation of good practices including leakage control, improved components, and end-of-life recovery and safety aspects • Build local capacity for technology conversion to lower-GWP alternatives • Promote reduction of RAC equipment charge size and improvements in energy efficiency • Ban non-essential imports of products containing high-GWP HFCs • Promote safe retrofit/replacement of refrigerants with lower GWP alternatives

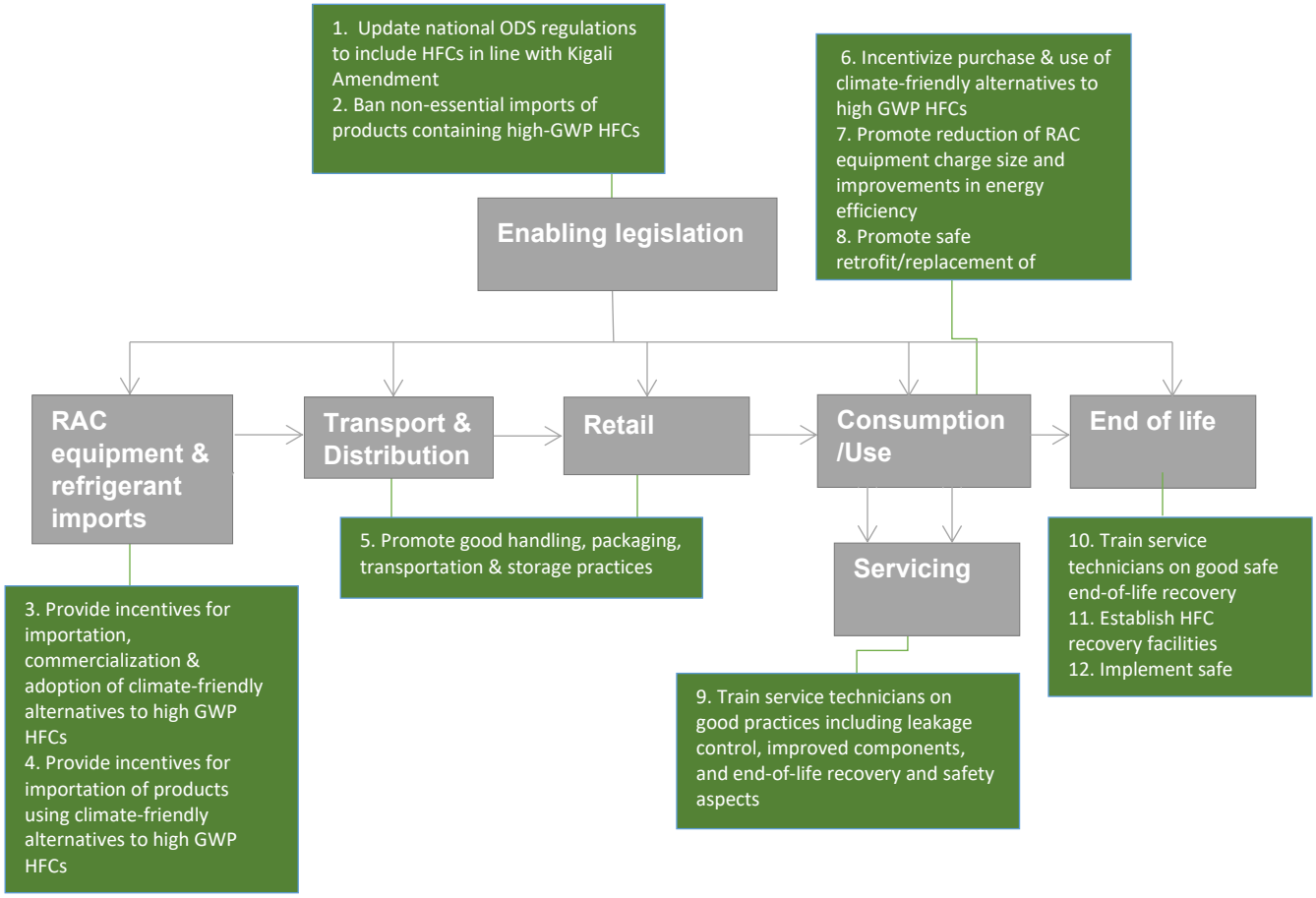


Figure 4.6. Implementation pathway: HFC Phase Out.

Commercial/Institutional Sector

Com_1: Commercial/Institutional Improved Efficiency

Switching to cleaner stoves and improving efficiency of charcoal cookstoves in commercial and service sector can significantly reduce SLCP emissions. Table 4.7 outlines the implementation strategies and actions for improved cooking fuel efficiency in commercial/institutional sector. Figure 4.7 lays out the implementation pathway for achieving improved efficiency of charcoal cookstoves in commercial and service sector.

Table 4.7. Implementation strategies and actions: Commercial/Institutional improved efficiency.

Sector	Energy
Measure	Energy efficiency
Target	50% of charcoal cookstoves in commercial and service sector are efficient in 2030

Context, current relevant policies, plans and projects	NDC 2.0 (2022)
Major Barriers	• Inadequate policy frameworks to support energy efficiency • High capital costs of energy efficient technologies • Low public awareness about energy efficiency technologies and the benefits thereof
Primary Responsibility	Ministry of Energy & Mineral Development
Actions	• Put in place enabling policies, regulations, and energy performance standards to support energy efficiency programmes • Provide fiscal incentives e.g. subsidies, tax exemptions, etc. to promote adoption of energy efficiency technologies • Enhance public education and awareness on benefits of using energy efficient technologies • Awareness-raising campaigns to inform consumers about the benefits of energy-efficient systems and appliances and to encourage their acceptance and preference for more energy-efficient products

Com_2: Commercial/Institutional Cleaner Fuels

Table 4.8 outlines the priority strategies and actions to achieve cleaner fuels in commercial/institutional sector in Uganda. The pathway to implementing the strategies and actions to achieve efficient biomass stoves and clean cooking is also presented in Figure 4.7.

Table 4.8. Implementation strategies and actions: Commercial/institutional cleaner fuel.

Sector	**Residential**
Measure	Commercial/institutional cleaner fuel
Targets	15% of woodstoves switched to LPG in 2030 30% of woodstoves switched to electricity in 2030
Context, current relevant policies, plans and projects	NDC 2.0 (2022)
Major Barriers	• Lack of /weak implementation of standards for efficient stoves • Inadequate technical capacity for local production of efficient stoves • High cost of raw materials • Lack of incentives for production and import of efficient stoves • Low testing capacity for quality of efficient stoves • Inadequate distribution networks for efficient stoves

	• High retail price of efficient stoves • Inadequate LPG and bioethanol bulk transport & distribution network • Inadequate LPG and bioethanol bulk storage capacity • Low LPG bottling capacity • High cost of LPG at retail level • Low awareness on benefits of using LPG for cooking • Safety concerns about LPG
Primary Responsibility	Ministry of Energy and Mineral Development
Actions	• Establish/implement standards for efficient biomass stoves • Build technical capacity for local production of efficient biomass stoves • Encourage use of locally available materials • Provide incentives for local production of efficient biomass stoves • Enforce existing standards • Incentivize import of efficient biomass stoves • Strengthen national quality/efficiency testing capacity for improved biomass stoves • Certify private testing laboratories • Expand distribution networks through public private partnerships • Provide incentives to reduce retail prices • Establish nationwide bulk transport & distribution for LPG • Expand nationwide bulk storage capacity • Expand LPG bottling capacity and distribution to retailers • Provide incentives to reduce LPG retail prices • Education & awareness on benefits of using LPG for cooking • Implement safety standards

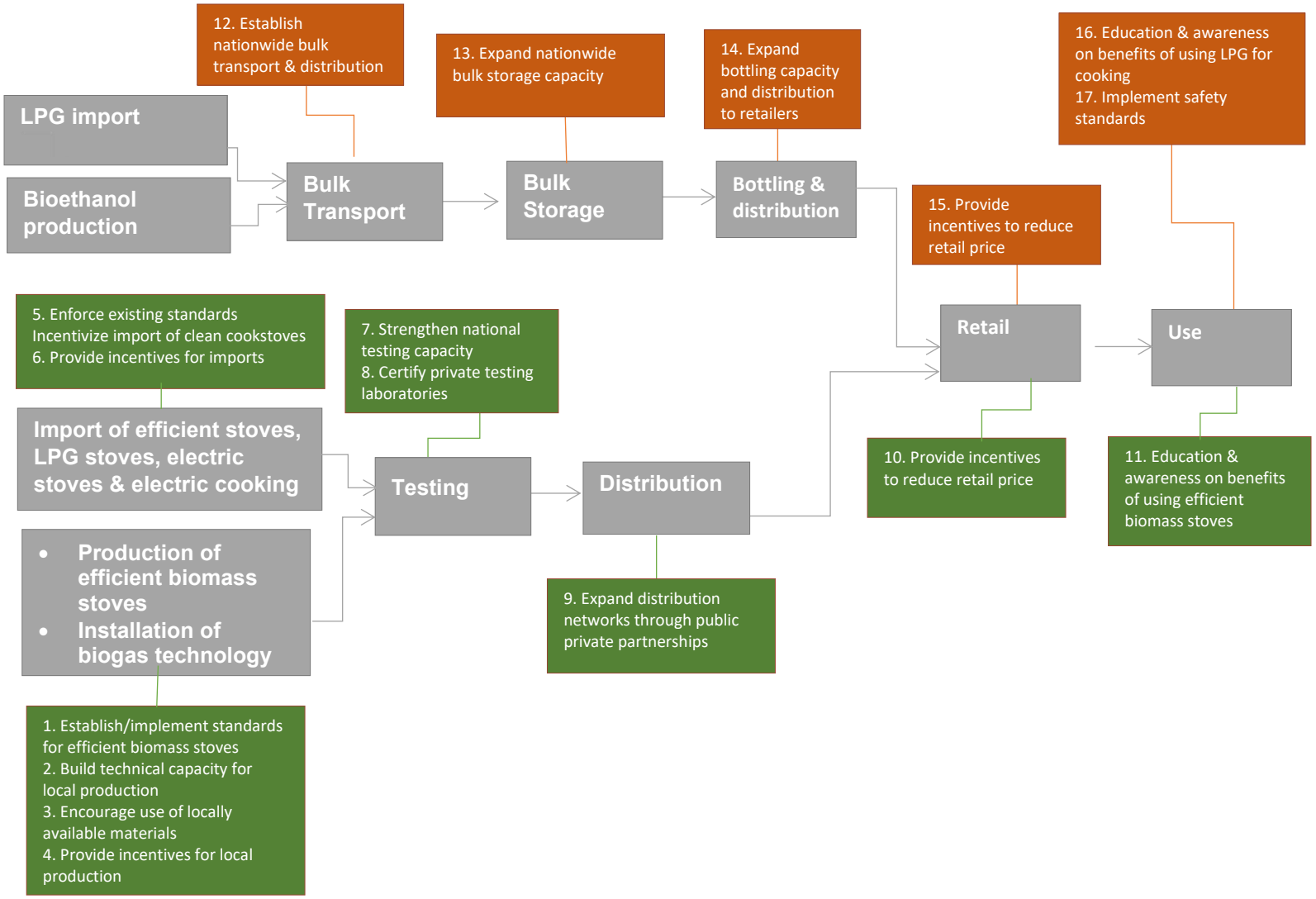


Figure 4.7. Pathway to implementing the strategies and actions to achieve efficient biomass stoves and clean cooking in the institutional/commercial sector.

Transport Sector

Tran_1: Non-Motorized Transport

Development of Non-Motorized Transport (NMT) infrastructure has the potential to shift demand from polluting travel options such as motorcycles in Uganda to safer, cleaner and healthier modes such as walking and cycling. The implementation strategies and actions for non-motorized transport are outlined in Table 4.9. The implementation pathway for Non-motorized Transport is outlined in Figure 4.8.

Table 4.9. Implementation strategies and actions: Non-motorized transport.

Sector	Transport
Measure	Non-motorized transport
Target	10% of passenger-km travelled by walking or cycling in 2030
Context, current relevant policies, plans and projects	NDC 2.0 (2022)
Major Barriers	• Lack of data to support decision making • Lack of enabling policies, laws and standards • Lack of infrastructure to support NMT • High cost of NMT investment • Inadequate local technical capacity for NMT implementation • Safety concerns due to poor existing infrastructure
Primary Responsibility	Ministry of Works and Transport
Actions	• Specification of NMT system requirements • NMT route selection & design • Develop enabling policy, legislation & standards for BRT • Budget & finance • Public private partnerships • Invest in safe NMT infrastructure • Education and awareness • Incorporate NMT in existing infrastructure in major cities and towns • Capacity building & technology transfer • Implement quality & safety standards

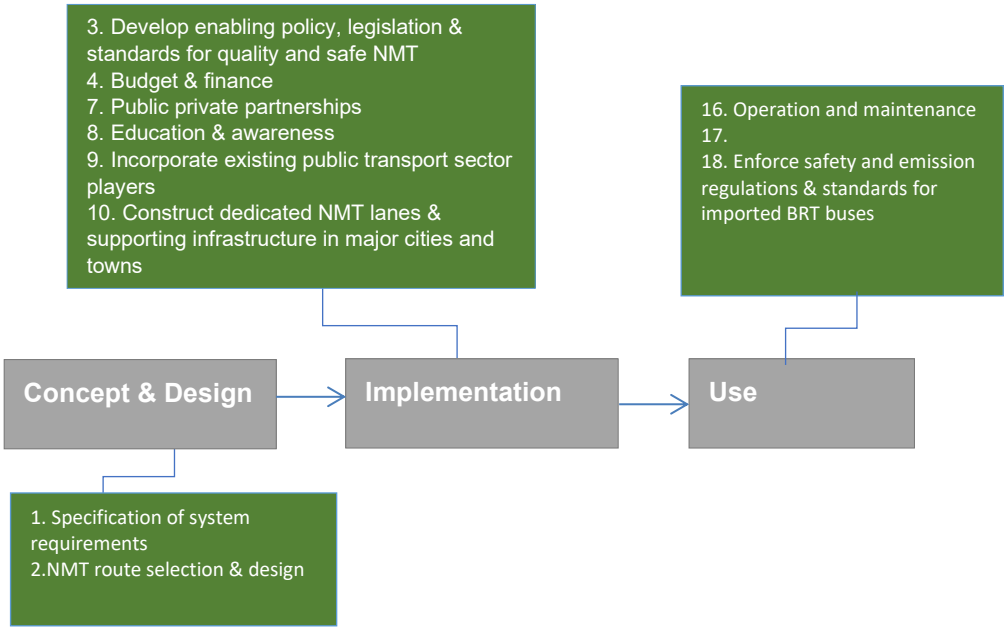


Figure 4.8. Implementation pathway non-motorized transport.

Tran_2: Fuel Efficiency, Tran_5: Euro IV, and Tran_6: Euro VI

Increasing the fuel economy of vehicles reduces the demand for petrol and diesel and reduces emissions associated with fuel combustion. Two emission control measures were included in this Plan, one targeting Euro IV by 2030 and one targeting the more stringent Euro VI by 2040. The strategies and actions related to fuel efficiency and the introduction of these standards are shown in Table 4.10, while Figure 4.9 outlines the implementation pathway for these measures.

Table 4.10. Implementation strategies and actions: Fuel efficient vehicles, Euro IV, and Euro VI emission standards.

Sector	Transport
Measures	Improve fuel economy of cars and introduce emission control standards (Euro IV and Euro VI) for HDVs in Uganda.
Target	Improve fuel economy (20% by 2030, 35% by 2040) By 2030 all newly registered HDVs in Uganda are Euro IV compliant By 2040 all newly registered HDVs in Uganda are Euro VI compliant
Context, current relevant policies, plans and projects	• Uganda National Energy Efficiency and Conservation Strategy, 2020 • Uganda Integrated Transport Policy, 2009 • East African Community (EAC) Standard 1047:2022
Major Barriers	• Weak implementation of existing standards for import and local manufacture of HDVs

	• Low research & development for local production of cleaner, fuel efficient vehicles • Lack of incentives for local production and importation of cleaner HDVs and fuel-efficient vehicles • Lack of incentives to encourage purchase of cleaner HDVs and fuel-efficient vehicles • Lack of data capture systems to support decision making on vehicle fuel efficiency • Weak implementation of existing roadworthiness & emission standards for in-use HDVs • Lack of scrappage/retirement policies for aged vehicles
Primary Responsibility	Ministry of Transport
Actions	• Implement & enforce minimum Euro 4/IV vehicle standard for imported and locally manufactured HDVs in line with Uganda Standard 1515:2019 • Enhance research & development for local production of cleaner HDVs and fuel-efficient vehicles • Provide incentives for local production and importation of cleaner HDVs and fuel-efficient vehicles • Provide fiscal incentives to encourage purchase of cleaner HDVs and fuel-efficient vehicles • Enhance vehicle registration and data capture systems to support decision making on vehicle fuel efficiency • Implement existing roadworthiness & emission standards for in-use HDVs • Roadworthiness inspection & emission testing in line with existing standards • Certify private garages to supplement national inspection centres • Develop and implement scrappage/retirement policies for aged vehicles • Recycling of end-of-life HDVs

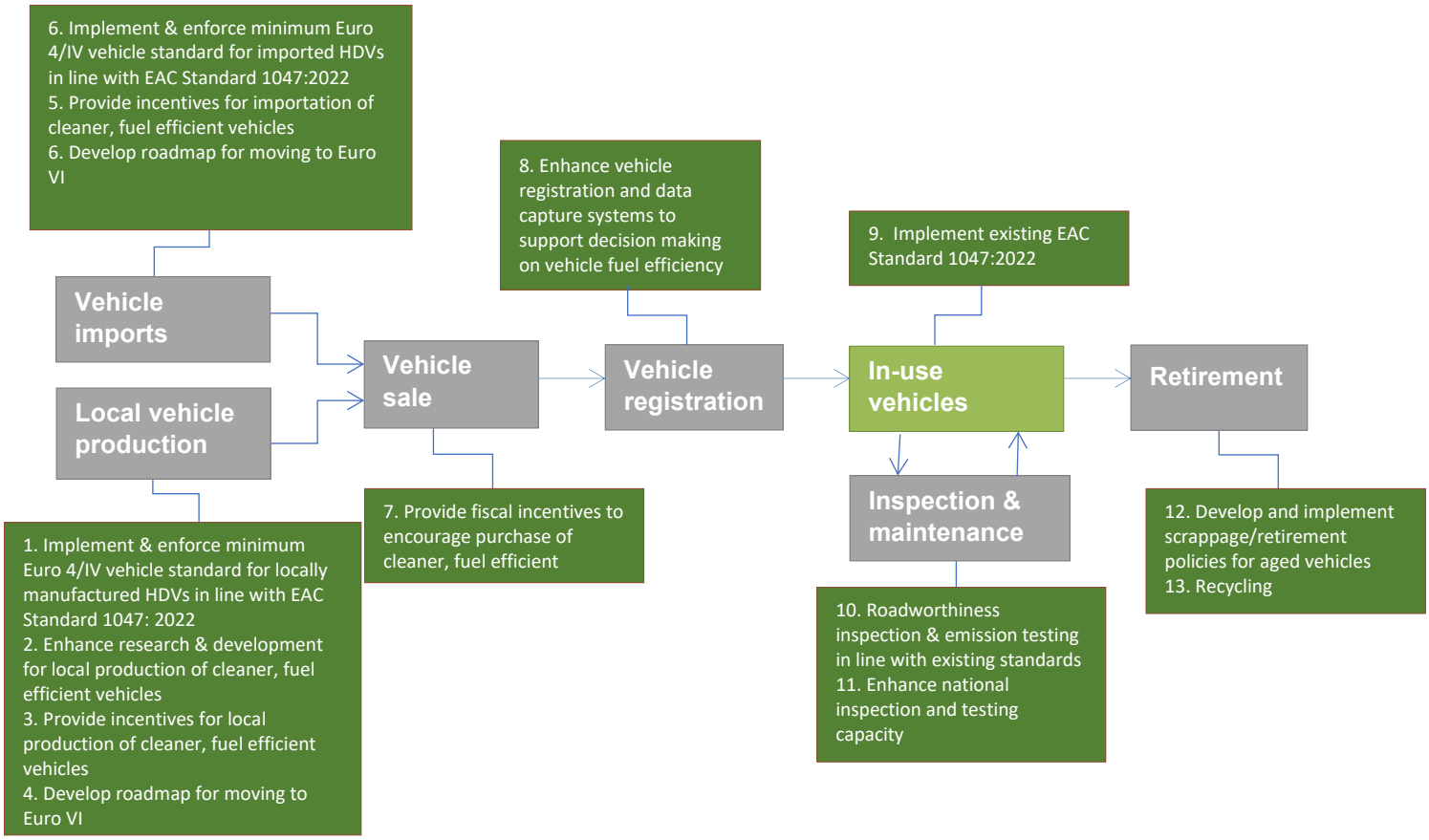


Figure 4.9. Implementation pathway: Fuel efficient vehicles, Euro IV, and Euro VI emission standards.

Tran3_ Electric Vehicles

Electric vehicles (EVs) can replace vehicles with a combustion engine (gasoline and diesel). The strategies and actions related to the introduction of electric vehicles is shown in Table 4.11. The implementation pathway for electric cars is outlined in Figure 4.10

Table 4.11. Implementation strategies and actions: Electric vehicles.

Sector	Transport
Measure	Electric vehicles
Target	100% of motorcycle passenger-km taken by electric motorcycle in 2030
Context, current relevant policies, plans and projects	Uganda's National E-Mobility Strategy (2023)
Major Barriers	• Inadequate policies & standards to support adoption of electric vehicles • High cost of electric vehicles and accessories • Inadequate electric vehicles charging infrastructure • Lack of incentives for local production and/or importation of EVs • High initial cost of EVs • Lack of data to support decision making • Low local capacity for inspection, maintenance & repair of EVs • Unstable/unreliable power supply • Environmental concerns for end-of-life EVs/batteries

Primary Responsibility	Ministry of Works and Transport
Actions	• Develop and implement policies and standards for local manufacture of EVs • Enhance R&D for local production of EVs • Provide incentives for local production of EVs • Develop and implement standards for imported EVs • Provide incentives for importation of EVs • Provide fiscal incentives to encourage purchase of EVs • Enhance vehicle registration and data capture systems for EVs & LPG cars to support decision making • Develop & implement roadworthiness standards for in-use EVs • Roadworthiness inspection for EVs & LPG cars • Build local capacity for maintenance & repair of EVs& LPG cars • Certify private garages to supplement NTSA inspection • Expand grid mix from renewable energy sources to power EVs • Enhance supply stability & reliability • Establish charging network for EVs • Provide incentives for investment in charging infrastructure • Develop and implement scrappage/retirement policies for aged vehicles • Implement recycling for end-of-life EVs/batteries

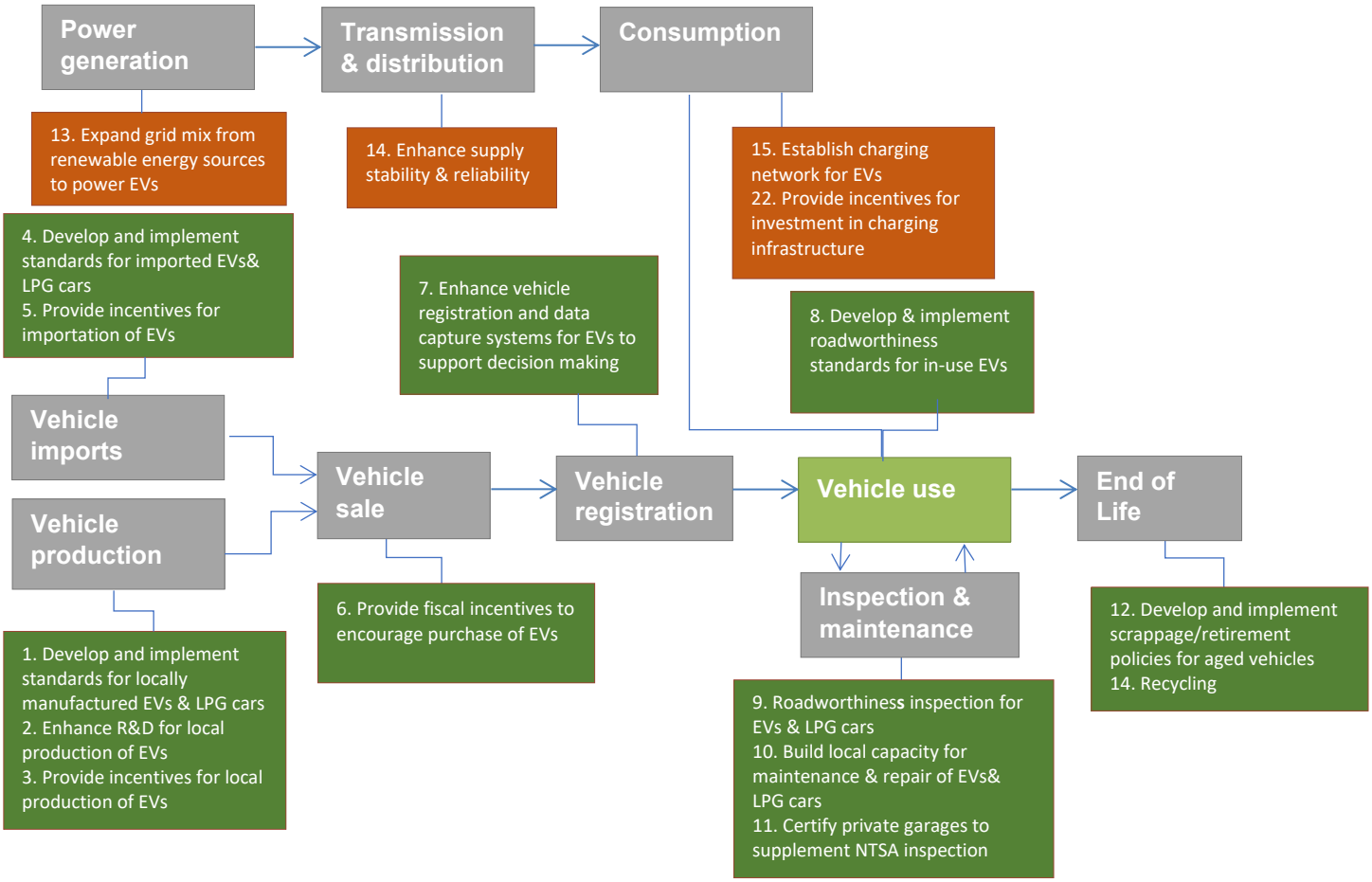


Figure 4.10. Implementation pathway: Electric vehicles.

Waste

Waste_1: Solid waste collection and Waste_3: Methane capture at landfill

Increasing waste collection has sanitary benefits and can reduce emissions from waste burning, but it could lead to increasing emissions from anaerobic treatment facilities. The Plan therefore also includes a measure where all landfills are fitted with methane capture technology. The barriers and necessary actions are shown in Tables 4.13 and 4.14 while the implementation pathway for all waste sector measures are shown in Figure 4.11.

Table 4.13. Implementation strategies and actions: Solid waste collection.

Sector	Waste
Measure	Waste Collection
Target	• 70% of urban waste is collected in 2030 • 70% of rural waste is collected in 2030
Context, current relevant policies, plans and projects	NDC 2.0 (2022)
Major Barriers	• Inadequate/weak enforcement of existing waste management policies/laws • Inadequate waste collection services • Low quality compostable waste due to contamination
Primary Responsibility	County Governments
Actions	• Public education and awareness • Enforce waste separation at source to reduce contamination of compostable waste • Enhance municipal waste collection services • Public private partnerships for investment in composting plants • Promote cleaner production to minimize waste

Table 4.14. Implementation strategies and actions: Methane capture at landfills.

Sector	Waste
Measure	Landfill gas capture
Target	• 75% of methane captured at anaerobic landfills 2040 • 10 % of methane at unmanaged shallow landfills in 2040
Context, current relevant policies, plans and projects	Additional measures
Major Barriers	• Inadequate/weak enforcement of existing waste management policies and laws • Low uptake of cleaner production technologies • Low awareness • Inefficient municipal solid waste management services

	• High cost of investment in waste to energy plants • Lack of sorting & material recovery facilities • Lack of engineered landfills to enable methane recovery for energy generation • Inadequate/weak enforcement of existing waste management policies and laws • Inadequate policies to support waste to energy investments • Inefficient waste to energy technologies • Poor quality waste due to contamination • High cost of investment in waste to energy projects
Primary Responsibility	Ministry of Energy & Petroleum
Actions	• Put in place enabling policies/laws/ regulations/standards to strengthen solid waste management policies & laws • Enact EPR regulations • Public education & awareness • Enhance municipal waste collection & transport services • Establish sorting & material recovery facilities • Enforce waste disposal regulations • Establish engineered landfills to enable methane recovery for energy generation • Establish plants to generate energy from methane recovered from landfills and wastewater • Establish plants to generate energy from waste combustion in efficient incineration plants • Public private partnerships • Public education and awareness

Waste_2: Sewage service coverage and Waste_4: Methane capture at wastewater treatment plants

As for solid waste collection, increasing the proportion of wastewater collected in anaerobic lagoons could increase methane emissions if treatment plants are not fitted with methane capture technology. This Plan therefore includes a measure to increase sanitation and wastewater treatment infrastructure and services through increased coverage of sewage services *as well as* methane capture at treatment plants. The barriers and necessary actions to these measures are shown in table 4.15 while the implementation pathway for all waste measures is shown in Figure 4.11.

Table 4.15. Implementation strategies and actions: Sewage service coverage and methane capture at wastewater treatment plants.

Sector	Waste
Measure	Increased sewage service coverage and methane capture from wastewater treatment plants
Target	31% of wastewater going to anaerobic deep lagoons by 2030 31% of wastewater in anaerobic digesters with methane capture by 2040
Context, current relevant policies, plans and projects	NDC (2022) plus additional methane capture measure
Major Barriers	• Inadequate/ weak enforcement of wastewater management policies & laws • Lack of wastewater infrastructure • Low uptake of cleaner production technologies • Low awareness • Inefficient municipal wastewater & sewerage services • Open lagoon engineering in existing wastewater & sewerage plants that do not support methane recovery • High cost of investment in waste to energy plants
Primary Responsibility	Ministry of Energy & Petroleum
Actions	• Strengthen wastewater management policies & laws • Enforce existing wastewater laws • Promote cleaner production to minimize waste • Public education & awareness • Enhance municipal wastewater collection & sewerage services • Re-engineer existing wastewater treatment plants to include anaerobic digesters to enable methane recovery • Construct new wastewater treatment plants to include anaerobic digesters. • Enforce standards for wastewater discharge • Establish plants to generate energy from methane recovered from wastewater

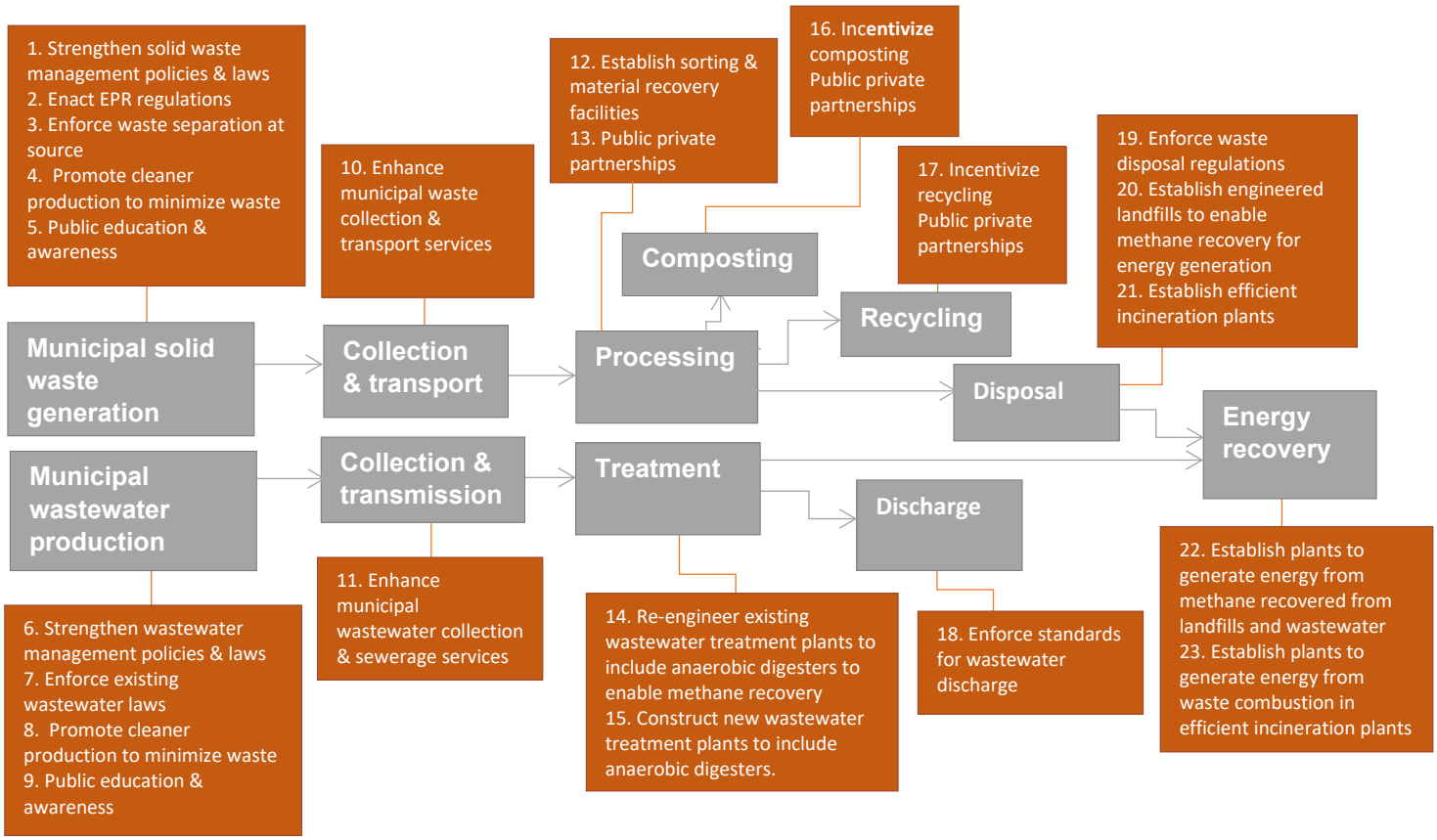


Figure 4.12: Implementation pathway for waste sector measures.

Agriculture

Ag_1: Animal Productivity

Increasing the production of meat and dairy per animal can reduce enteric fermentation and manure management emissions by reducing the number of animals required to meet the same demand for food. This proposed measure is currently not in any national policies. The major barriers and actions are shown in Table 4.16 and the implementation pathway for this measure is shown in Figure 4.16.

Table 4.16. Implementation strategies and actions: Animal productivity.

Sector	Agriculture
Measure	Animal Productivity
Target	Increase production per animal of meat and dairy to achieve the same production with a smaller herd size
Context, current relevant policies, plans and projects	Additional measure

Major Barriers	• Poor animal husbandry practices • Low performing animal breeds • Poor feed quality • Feed loss & waste • High cost of quality feed • Inefficient animal production practices that favour numbers over quality • Poor pasture & grassland management • Low uptake & usage of crop residues as feeds • Low/non-existent extension & advisory services • Poor feeding practices • Poor manure handling, composting, storage and application practices • Low knowledge on biogas capture for domestic use • High investment costs of biogas units
Primary Responsibility	Ministry of Agriculture, Animal Industry and Fisheries
Actions	• Breeding and promotion of adaptable forage crops with good quality nutrient composition • Promote better animal health • Promote efficient livestock breeds • Promote optimization of feed digestibility • Promote dietary balance, diversity & optimization of feed rations • Promote reduction of feed loss & waste • Incentivize production of quality, affordable feed • Promote reduction in ratio of animals dedicated to reproduction to animals dedicated to production • Improve pasture & grassland management in grazing systems • Enhance extension & advisory services • Education and awareness creation

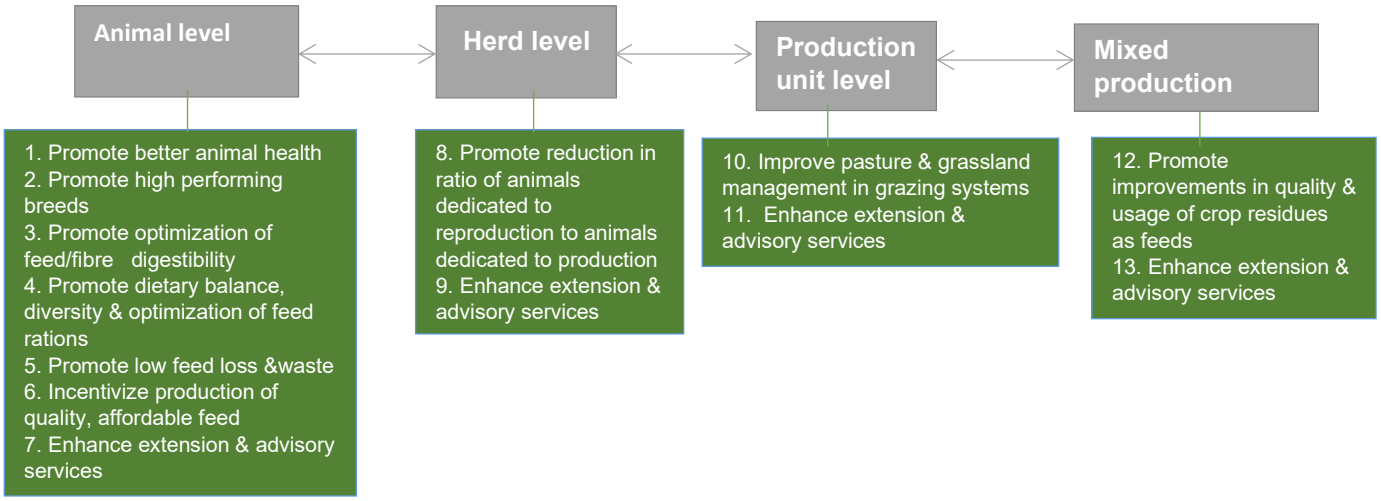


Figure 4.13. Implementation pathway for increased animal productivity.

5. Monitoring implementation of Short-Lived Climate Pollutants measures

This national SLCP Plan outlines 19 specific actions, which, if implemented could reduce SLCP emissions by 17% (methane) and 37% (black carbon) by 2035. Hence, this plan can make a substantial contribution to the Uganda's international climate change commitments, including its NDC, and as a contribution to achieving the goals of the Uganda 2040 Vision and National Development Plans. However, the benefits that this Plan outlines from the 19 priority SLCP actions will remain theoretical if actions are not taken to implement them. Monitoring and tracking progress on the implementation of the National SLCP Plan is therefore critically important. Effective monitoring ensures that:

1. Successes in the implementation of priority SLCP measures are quantitatively demonstrated and verified and the benefits of these measures are shown and can be communicated through tracking, review and evaluation of progress against the targets and indicators.
2. The National SLCP Plan can be revised if needed as a result of either the successful achievement of the plan meaning that a focus can be placed on other sectors, or challenges in the implementation requiring a revised plan to achieve climate and clean air benefits.
3. During the implementation of the National SLCP Plan, progress on the implementation of the measures can be tracked and regularly reviewed.

We recommend that the monitoring of the National SLCP Plan is done using two sets of indicators, i) indicators of success, and ii) indicators of implementation. Indicators of success demonstrate whether the intended goal of the plan is actually being achieved. Indicators of implementation track progress on whether the components of the plan (i.e. the 19 priority mitigation measures) are being successfully implemented. These two levels of indicators allow the Government of Uganda, and other stakeholders to understand possible scenarios related to the implementation of the National SLCP Plan (Figure 5.1). For example, if the indicators of implementation show that the 19 priority measures are being implemented as intended, and the indicators of success show that SLCP emissions are being reduced at the level estimated within the National SLCP Plan, then both indicators consistently show that the plan is being implemented as intended and is having its intended effect. If the indicators of implementation show that progress is not being made as intended with some of the measures, and the indicators of success show that SLCP emissions are not reducing, then a revision to the plan may be necessary. If indicators of implementation show measures are being implemented but SLCP emissions are not reducing, then some assumptions about the effectiveness of those measures may need to be assessed as to why those measures are not reducing emissions (e.g. measures may not be being enforced, socioeconomic development may increase emission faster than measures can control them).

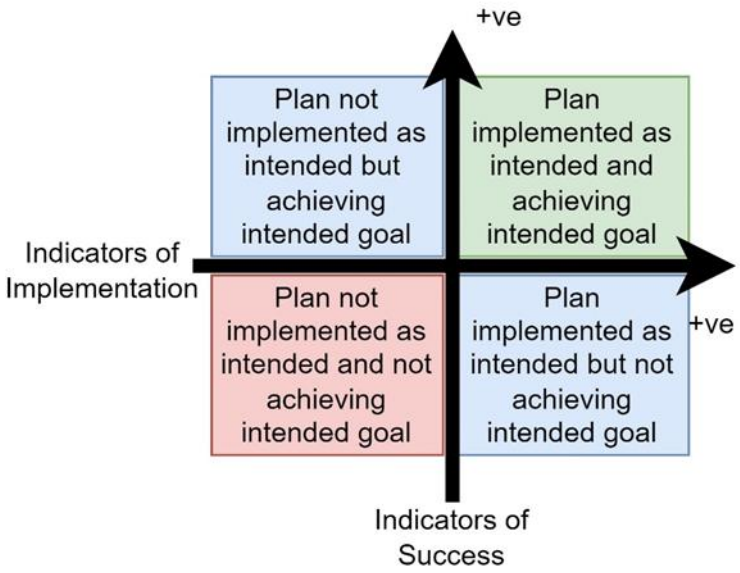


Figure 5.1. Combination of indicators of success and implementation and how they evaluate implementation of the Uganda National SLCP Plan.

We recommend that the indicators of success and indicators of implementation for the National SLCP Plan are monitored as part of Uganda's broader climate change monitoring, reporting, and verification systems, such as the official reporting of the Government of the Uganda to the UNFCCC. The reason for this recommendation is that there is a substantial overlap between the indicators needed to monitor climate change targets and plans (e.g. nationally determined contribution) and the National SLCP Plan. Monitoring SLCPs within existing climate change monitoring frameworks creates efficiencies in terms of data collection, quality assurance, and data management. The subsections below describe the indicators of success and indicators of implementation that could be used to monitor the implementation of the national SLCP plan within climate change monitoring frameworks.

5.1. Indicators of Success

The ultimate goal of the national SLCP plan is to reduce emissions of key SLCPs including, methane, black carbon, and hydrofluorocarbons, and to simultaneously reduce greenhouse gases and air pollutants to achieve climate change mitigation alongside improvements in public health through improved air quality. Therefore, the primary indicators of success are national total emissions of SLCPs and other air pollutants. The Ugandan government already published national total emissions of greenhouse gases through its national greenhouse gas inventory. Most recently, emissions up to 2017 were reported in Uganda's Third National Communication submitted to the UNFCCC Ministry of Water and Environment (2022b). It adheres to the methodological and data protocols outlined in the Intergovernmental Panel on Climate Change's Guidelines for the development of national emission inventories. It is therefore recommended that SLCPs (black carbon) and other air pollutants (organic carbon, particulate matter, nitrogen oxides, sulphur dioxide, non-methane volatile organic compounds, ammonia, and carbon monoxide) are integrated and quantified as part of the Uganda' National greenhouse gas emission inventory.

Methane and HFCs are already quantified within Uganda's National greenhouse gas emission inventory and therefore do not need to be added. However, updating emission estimates using Tier 2, more detailed methodologies would substantially improve the robustness of these SLCP emission estimates. For black carbon and other air pollutants, many countries have already integrated emissions of these pollutants into their national GHG emission inventories, and comprehensive guidance to achieve this is already available. The methodologies and data required to quantify emissions of black carbon and other air pollutants strongly overlap with those for greenhouse gases, meaning that many of the data needed is already collected through the national greenhouse gas inventory process. As the technical analysis in Sections 2 and 3 demonstrate, an integrated analysis of greenhouse gases, SLCPs, and air pollutants is possible to conduct historically and for future projections. Doing this within the national greenhouse gas emission inventory means that there is a regular process for updating and refining the inventory.

Additional indicators of success that could be considered could include the concentrations of health-damaging air pollutants in the atmosphere across Uganda and/or the health burden (e.g. number of attributable deaths) associated with exposure to $PM_{2.5}$. While these indicators capture trends in the ultimate problem that the National SLCP Plan aims to solve, these indicators are also further removed from the consequences of implementing the 19 priority measures in the plan. For example, $PM_{2.5}$ concentrations across Uganda are impacted not just by emissions from different sources but by atmospheric transport and chemical transformation, as well as contributions from emissions transported from other countries (see Section 3.3). Health burdens, in addition to being impacted by the same additional factors as $PM_{2.5}$ concentrations, are also impacted by demographic and health trends. Therefore, while these indicators could be considered supplemental indicators of success, we recommend that national total emissions of SLCPs and air pollutants be used as the primary success indicator because of the closer link between the implementation of action and the reduction in emissions.

5.2. Indicators of Implementation

Indicators of implementation aim to capture whether a measure is being implemented as intended. These indicators therefore require data to be collected on the extent to which changes in a particular sector or system are being implemented. Therefore, data providers will differ in the indicators that assess the implementation of each individual measure. The recommended indicators of implementation are shown in Table 5.1. We recommend that indicators of implementation are identified across climate change-relevant plans and that a centralized platform is used to report all indicators together. This can be supervised by the Climate Change Department (CCD) of the Ministry of Water and Environment since they oversee the establishment and maintenance of the national greenhouse gas inventory. This will provide the clearest view as to where progress is being made and where challenges are being experienced in the implementation of mitigation measures. Support could be provided by the Inter-Institutional Climate Change Technical Committee as they are bridge between the CCD and the respective institutions providing data for the emission inventory. Each indicator of implementation should be collected ideally on an annual basis. However, this may not be practically possible. In many cases, these indicators may already be collected by departments or agencies within Uganda. For example, the proportion of households cooking using biomass may be collected in household surveys. In these cases, the indicator can be collected within these existing data collection

processes. In some cases, indicators may be able to be added to existing data collection procedures (such as the census or household surveys) as the most efficient way of collecting this information.

Table 5.1. Indicators of implementation for mitigation measures included in the National SLCP Plan.

Sector	Measure Ref	Measure Description	Details	Timeline Target	Indicator of implementation	Frequency of collection	Responsibility for collection
Energy	Res_1	Efficient Stoves and Clean Cooking	Access to efficient cookstoves and cleaner fuels will increase	2040	Fraction of households using clean fuels	Annually	Ministry of Energy and Mineral Development
	Res_2	Energy Efficiency	75% reduction in energy use for lighting in 2030	2030	Energy used for lighting per household	Annually	Ministry of Energy and Mineral Development
	Energy_1	Transmission and distribution losses	Strengthening electricity transmission and distribution infrastructure	2030	Percent of electricity loss	Annually	Ministry of Energy and Mineral Development
	Energy_2	Efficient charcoal kilns	Increasing the efficiency of charcoal kilns	2030	Efficiency of charcoal kilns	Annually	Ministry of Energy and Mineral Development
	Ind_1	Industrial Energy Use	Increasing energy efficiency	2030	Energy consumed per output	Annually	Ministry of Energy and Mineral Development
	Com_1	Commercial/Institutional Improved Efficiency	Improved efficiency of charcoal cookstoves in commercial and service sector	2030	Efficiency of charcoal stoves	Annually	Ministry of Energy and Mineral Development
	Tran_1	Non-Motorised Transport	Development of non-motorized transport infrastructure	2030	Fraction of passenger-km taken by non-motorised transport	Annually	Ministry of Works and Transport
	Tran_3	Fuel Efficiency	Improve fuel economy (20% by 2030, 35% by 2040)	2030, 2040	Fuel economy of vehicles	Annually	Ministry of Works and Transport
	Tran_4	Electric Vehicles	Uganda fully transitioned to e-Mobility in public transport and motorcycles by 2030 and passenger vehicle sales by 2040	2030, 2040	Fraction of vehicles which are electric	Annually	Ministry of Works and Transport
	Tran_5	Euro IV	By 2030 all newly registered HDVs in Uganda are Euro IV compliant	2030	Number of vehicles added to vehicle fleet meeting Euro 4 standards	Annually	Ministry of Works and Transport
	Tran_6	Euro VI	By 2040 all newly registered HDVs in Uganda are Euro VI compliant	2040	Number of vehicles added to vehicle fleet meeting Euro 6 standards	Annually	Ministry of Works and Transport
	Tran_7	Rail fuel economy	22% improvement of diesel locomotives achieved in 2030 relative to 2015	2030	Fuel economy of locomotives	Annually	Ministry of Works and Transport

Waste	Waste_1	Waste collection	Efficiency of solid waste collection	2030	Volume of municipal solid waste collected	Annually	National Environment Management Authority
	Waste_2	Sewage service coverage	Increase to sanitation and wastewater treatment infrastructure and services through increased coverage of sewage services	2030	Fraction of liquid waste collected in sewers	Annually	National Environment Management Authority
	Waste_3	Methane capture at landfill	Assumed all landfills are fitted with methane capture technology.	2040	Fraction of landfill gas collected	Annually	National Environment Management Authority
	Waste_4	Methane capture at wastewater treatment plants	Methane will be captured at centralised anaerobic wastewater treatment plants	2040	Fraction of wastewater treated in anaerobic treatment plants	Annually	National Environment Management Authority
Agriculture	Ag_1	Animal productivity	Production per animal of meat and dairy will increase to achieve the same production with a smaller herd size.	2050	Carcass weight and milk yield	Annually	Ministry of Agriculture, Animal Industry and Fisheries
IPPU	Ind_2	HFC Phase Out	Compared to the 2020-2022 average, a 10% reduction in consumption of HFCs by 2029, a 10% reduction by 2035, and a 50% reduction by 2040	2035, 2040	Fraction of refrigeration and air conditioning equipment sold containing low-GWP refrigerants	Annually	Ministry of Industries, Tourism and Cooperative

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