# National Greenhouse Gas Emissions Report

## Inventory Summary 2017

**REPUBLIC OF MALAWI**

*The Ministry of Natural Resources, Energy and Mining*

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# BACKGROUND

Human activity has directly contributed to increased concentrations of greenhouse gases (GHGs) in the atmosphere, leading to an overall warming of the planet. Activities such as the burning of fossil fuels or clearing of forests over the past century have released vast amounts of GHGs, leading to accelerated rates of climate change worldwide. Rising global temperatures invariably lead to more extreme weather events, intensifying the severity or frequency of droughts, floods, and storms (IPCC, 2014).

To address this global crisis, in 1992, countries from around the world signed the UN Framework Convention on Climate Change (UNFCCC) whereby signatories committed to reduce greenhouse gas emissions. Parties to the convention agreed to periodically submit National Communications to the UNFCCC describing national anthropogenic GHGs by sources and removals as quantified through a national inventory.

As a party to the UNFCCC, Malawi has prepared two National Communications (December 2003 and May 2012). This report summarizes national emissions in Malawi for the year 2017 that will contribute to the next National Communication. As such, it is divided into emissions from the four sectors as defined by the UNFCCC, including energy, industrial processes and product use (IPPU), agriculture, forestry and other land use (AFOLU), and waste.

The analyses undertaken to generate these results were performed using **Malawi's Greenhouse Gas Inventory System (GHG-IS)**, launched in 2019. Through documented procedures and processes for collecting data and programmed emissions calculators, the GHG-IS combines local data with methods and procedures documented in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories to archive and quantify national GHG emissions from each IPCC Sector.

# Results

## Total 2017 Emissions

In 2017, total emissions in Malawi were estimated to be 13,416,336 t $CO_2e$. Emissions were overwhelmingly dominated by activities in the Agriculture, Forestry, and Other Land Use (AFOLU) sector, which contributed 75% of total emissions (See Figure 1 where AFOLU sub-categories are shown in green colors). This is largely attributed to emissions generated by livestock (27% of the total) as well as forest degradation from unsustainable fuelwood harvesting (24% of the total).

Emissions from the Waste sector contributed 14% of total emissions, with emissions from the Energy sector following at 10% and emissions from the Industrial Processes and Product Use (IPPU) sector made up only 0.4% of total emissions.

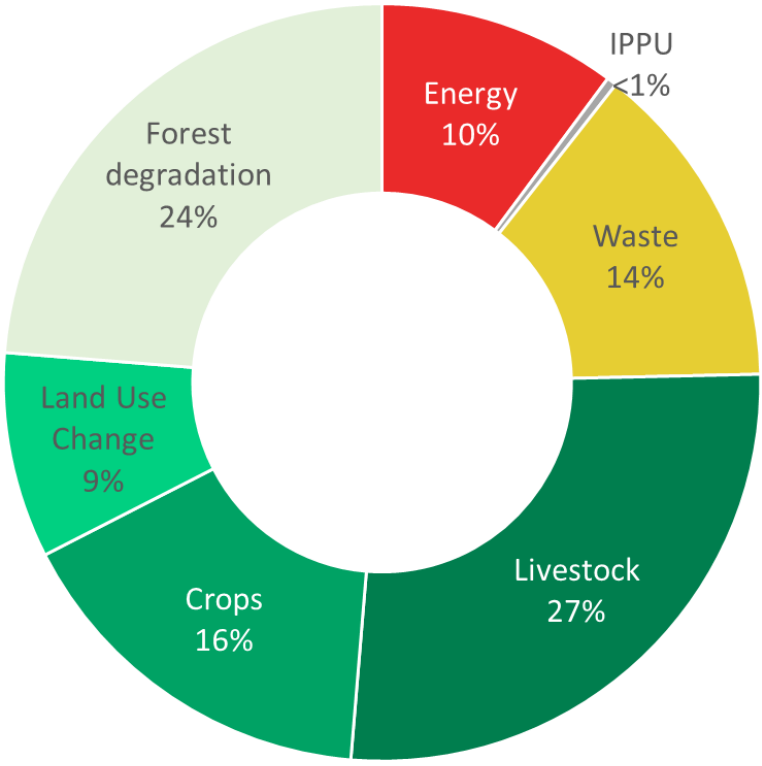


*Figure 1 Emission contributions by sector in Malawi, 2017. Green categories are sub-categories within the AFOLU sector.*

*Table 1 Emissions by sector in Malawi, 2017*

| IPCC Sector | Emissions (t $CO_2e$) |
|---|---|
| Energy | 1,364,464 |
| IPPU | 56,633 |
| AFOLU | 10,108,598 |
| Waste | 1,886,640 |
| Total | 13,416,336 |

## Greenhouse Gases

The three greenhouse gases included in Malawi's GHG Inventory are carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$).

As shown in Table 2 and Figure 2, carbon dioxide was the single largest greenhouse gas emitted in 2017 at 41% of the total, but methane emissions were a close second at 39%. Nitrous oxide emissions contributed 20% of the total.

The significant role methane emissions play in Malawi's GHG profile can in large part be attributed to the outsized role livestock activities play in Malawi's 2017 GHG profile.

Table 2 *Emissions by GHG in Malawi, 2017*

| GHG | Emissions in original gas | Emissions t $CO_2e$ |
|---|---|---|
| Carbon Dioxide<br>t $CO_2$ | 5,520,312 | 5,520,312 |
| Methane<br>t $CH_4$ | 187,949 | 5,262,576 |
| Nitrous Oxide<br>t $N_2O$ | 9,938 | 2,633,448 |
| Total | | 13,416,336 |

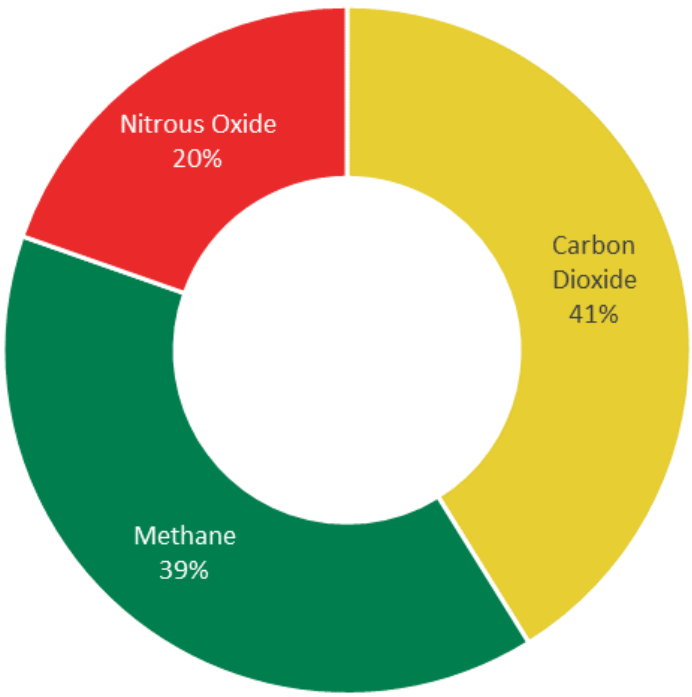


*Figure 2 GHG contributions by type in Malawi, 2017*

## Historical Trends

Emissions in Malawi have steadily grown, increasing 35% over the seven-year 2010-2017 timespan. This growth mirrors Malawi's significant population increase[1] over the same timespan of 22%.

Emissions from waste and livestock stand out as having increased significantly over this timespan, and this is tied to data applied from actual census figures on population and livestock numbers which grew over the 2010-2017 time period.

The Second National Communication submitted in 2011 determined that emissions from energy were the second largest emitting sector in the country. Results from the GHG-IS from 2017 show that this has changed, with emissions from the waste sector exceeding energy emissions. This can be attributed to the steady increase in population. Therefore, as trends in population growth continue, it is likely that emissions from waste management will increase in future inventories.

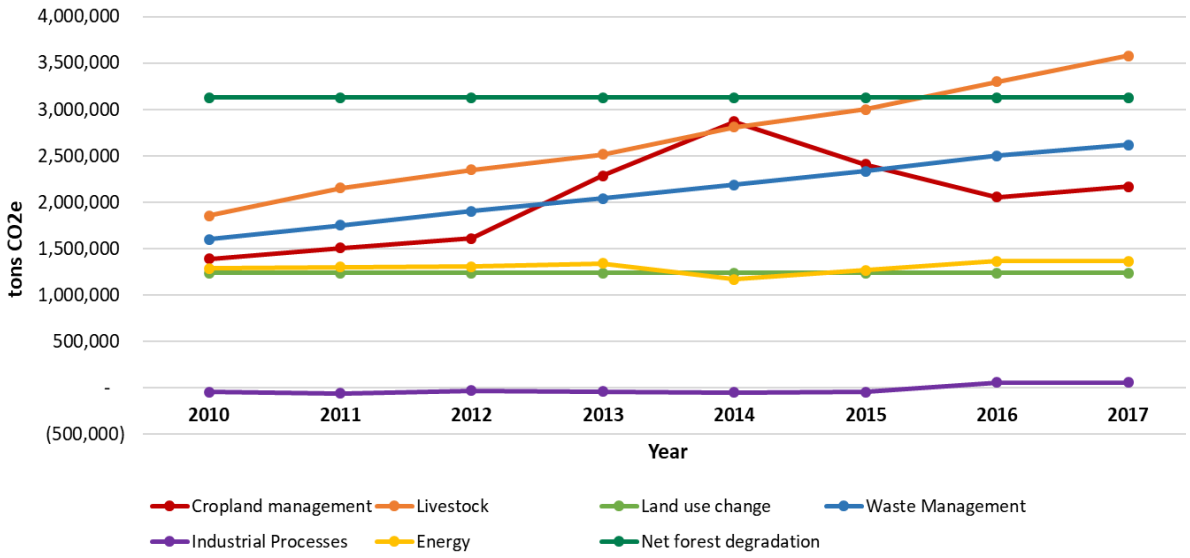


*Figure 3 Historical Emissions Trends by Sector in Malawi 2010-2017*

[1] https://www.google.com/publicdata/explore?ds=d5bncppjof8f9_&met_y=sp_pop_totl&hl=en&dl=en

# Energy Sector

Emissions from Malawi's energy sector are comprised of those from fossil fuel and wood fuel combustion, and fugitive emissions from coal mining. In 2017, these emissions were estimated to be 1,364,464 t $CO_2e$, comprising 10% of total annual emissions. Emissions from the energy sector were the third largest among all sectors in the country.

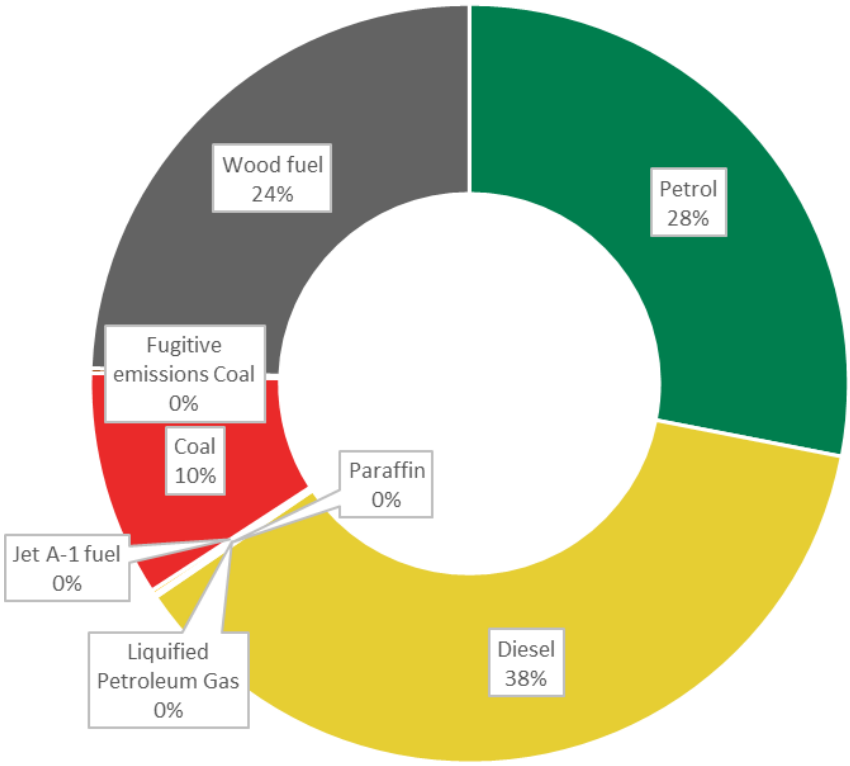


*Figure 4 Emissions contributions energy sector source in Malawi, 2017*

This contrasts with global trends where energy sector activities are the single greatest source total greenhouse gas emissions (49%)[2] due to global dependence on fossil fuels for energy. Malawi's emissions are comparatively low because most of Malawi's electricity is supplied via hydropower rather than coal or other non-renewable, fossil fuel energy sources. However, the electrification rate is low, at 10%. While higher in urban settings (25%), only 5% of rural households have access to electricity[3].

To meet cooking and heating needs, most Malawians (up to 98%) turn to wood fuels which make up 24% of energy sector emissions. While burning wood fuels for energy makes up a relatively small part of total emissions, unsustainable harvesting of these wood fuels which leads to forest degradation is a dominant source of emissions in Malawi and is accounted for under the AFOLU sector.

[2] https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data#Sector

[3] https://www.energy.gov.mw/index.php

Nevertheless, if responsibly managed and sourced, wood fuels can be a sustainable and renewable source of energy.

Fossil fuels (i.e., petrol, diesel, liquified petroleum gas, jet fuel, coal, and paraffin, and fugitive emissions from coal) make up over 75% of energy sector emissions in Malawi in 2017. Looking to the future, as demand for transportation increases along with Malawi's growing population, and energy needs compound in Malawi's swelling urban centers to fuel transportation and household needs, emissions from the energy sector are expected to rise.

## Industrial Processes and Product Use Sector

Emissions from the industrial processes and product use (IPPU) sector were the smallest across all sectors in Malawi in 2017, at just 0.4% of the total. Activities in this sector include cement, lime, and ceramics production. No data on ceramic production were available in 2010-2017 so emissions from this activity are estimated to be zero.

Historically, activities in this sector have resulted in net removals of carbon dioxide from the atmosphere, resulting in negative emissions estimates. Historically, the majority of clinker used in cement production has been imported, so emissions from clinker production, which make up the majority of emissions in cement production, are accounted for in their origin country. During cement curing which occurred in Malawi, carbon dioxide is removed from the atmosphere, and therefore emissions from the industrial processes sector were negative. However, starting in 2016, clinker production rose, driving up emissions from this sector. In 2017, cement production comprised just under 44% of IPPU emissions.

Lime production, the other source of IPPU sector emissions in Malawi, was the only source of emissions from this sector until 2016. In 2017, it made up just over half of total IPPU sector emissions at 55%.

## Agriculture, Forestry, and Other Land Use Sector

Emissions from the Agriculture, Forestry, and Other Land Use (AFOLU) sector in Malawi were by far the largest, contributing 75% of total emissions. Activities included within this sector include agricultural soil management (i.e., fertilizer and pesticide inputs for crops), rice cultivation, livestock, land use change (i.e., deforestation), and forest degradation. Given approximately 80% of Malawi's

population are comprised of smallholder farming households[4], the outsized role the AFOLU sector plays in Malawi's emission profile is understandable.

## Agriculture

Agricultural emissions include those from managed agricultural soils and livestock. In 2017, livestock emissions made up 62% of agriculture emissions (27% of total national emissions) and agricultural soil (cropland) management emissions contributed 38% of agriculture emissions (16% of total emissions).

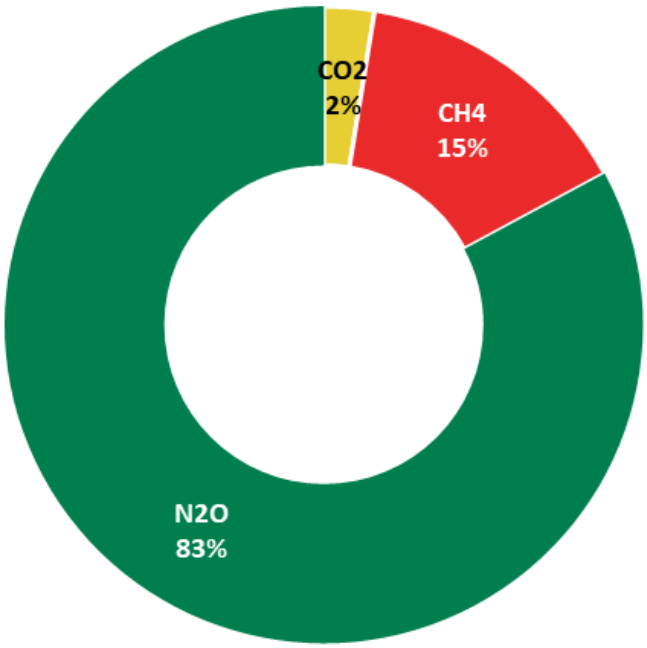


*Figure 5 Emissions contributions by GHG for managed agricultural soils (croplands) in Malawi, 2017*

Emissions from managed agricultural soils in Malawi are attributed to the application of manure and other fertilizer inputs to improve productivity. This produces nitrous oxide emissions, which has a particularly large impact due to its greater potency (i.e., radiative forcing) in terms of global warming potential, as Figure 5 depicts.

Livestock emits methane and nitrous oxide, which come from manure management and enteric fermentation. As shown in Figure 6, cattle, goats, and swine were the largest livestock emitters in 2017. Goats and cattle were the largest contributors due to the methane they produce during their digestive processes (i.e., enteric fermentation) and swine due to the methane and nitrous oxide emitted from the manure management systems commonly applied for this type of livestock.

[4] https://www.usaid.gov/malawi/agriculture-and-food-security

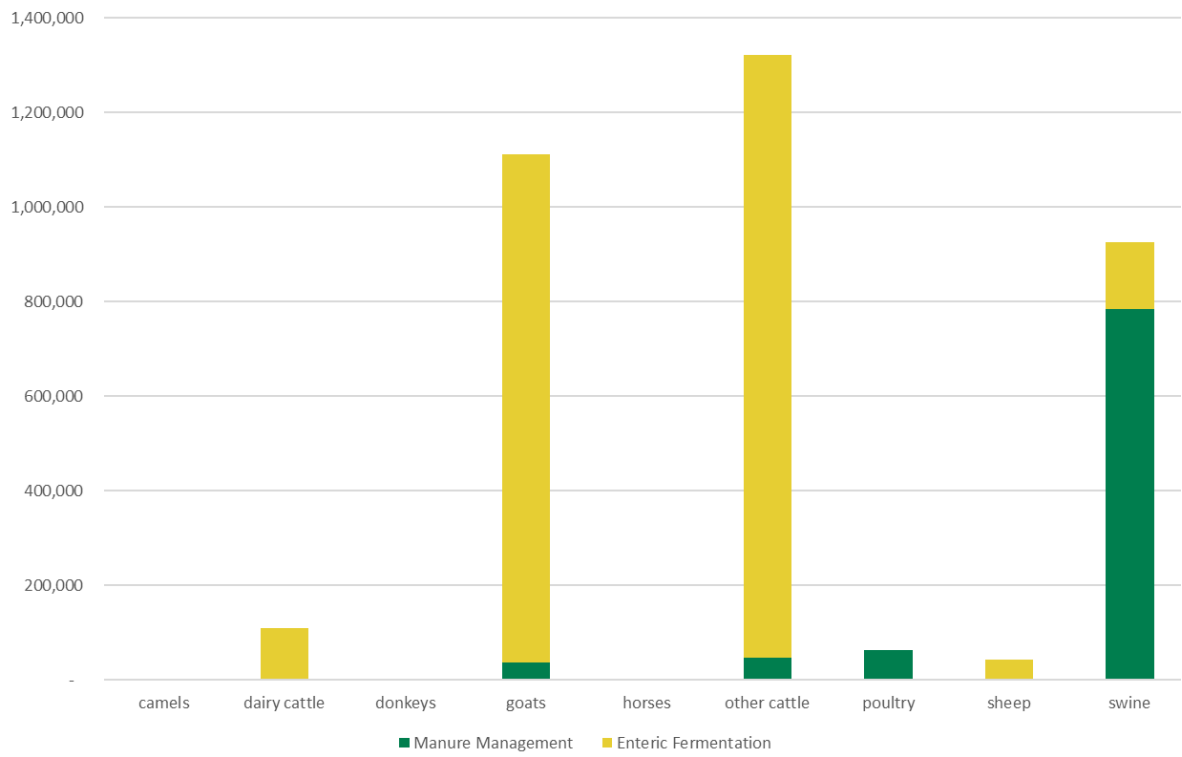


*Figure 6 Emissions from livestock in Malawi, 2017. "other cattle' refers to non-dairy cattle.*

## Forestry

Emissions from forestry activities in Malawi made up 33% of total emissions in Malawi, and includes deforestation, forest degradation, and forest enhancements (plantations). Emissions from forestry activities were dominated by the 'forest remaining forest'[5] or forest degradation category, which refers to activities associated with unsustainable extraction of wood fuels. This made up 24% of Malawi's total emissions, the second largest single contributor after livestock.

Table 3 *Emissions by greenhouse gas in Malawi, 2017*

| Forestry activity gross emissions | t $CO_2$ |
|---|---|
| Deforestation | 1,236,575 |
| Forest Degradation | 3,184,656 |
| Enhancements | -57,964 |
| Total | 4,363,267 |

To meet the demands of a growing population highly dependent on wood fuel, unmanaged wood fuel extraction has led to severe degradation of Malawi's forests. Emissions from land use change include both deforestation and forest enhancements, and their net

[5] 'Forest remaining forest' refers to the forest land in Malawi that has not experienced a land use change over the reported period

emissions make up 9% of Malawi's total emissions. Gross emissions from deforestation and gross removals from enhancements are shown in Table 3. Forest enhancements, which under Malawi's GHG-IS includes forest plantation activities in Malawi's tobacco estates and customary lands. These activities lower net emissions by removing carbon dioxide from the atmosphere. Promoting forest plantation activities and sustainable fuel wood collection and use would lead to mitigating emissions produced from this sector in Malawi.

## Waste Sector

Waste sector emissions made up 14% of the total emissions in Malawi and include wastewater treatment and discharge, incineration and open burning of waste, and solid waste disposal.

Emissions from this solid waste disposal primarily come from methane produced as organic matter decomposes. Nitrous oxide emissions are produced during the burning process and therefore are part of total emissions in the incineration and open burning of waste category (mainly open burning).

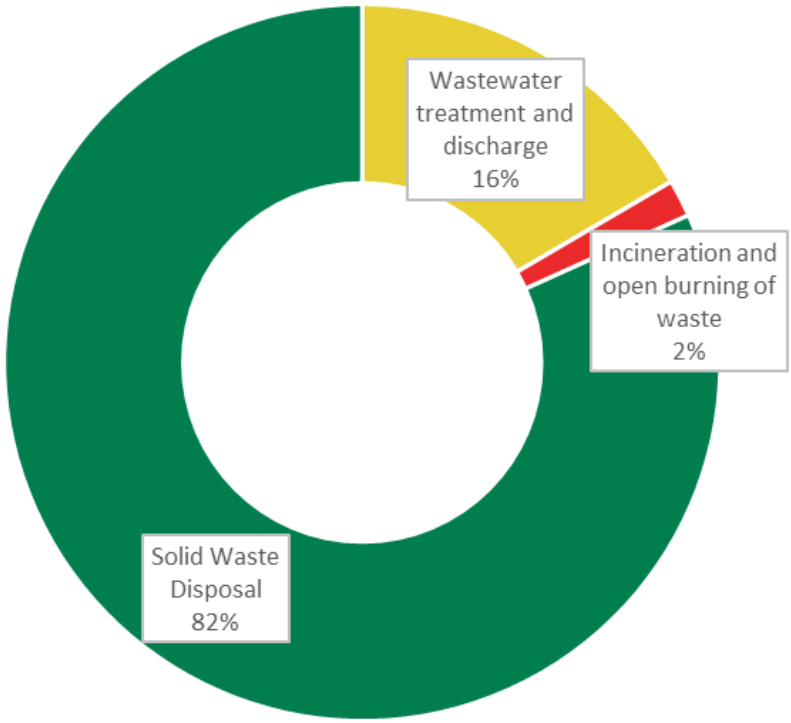


*Figure 7 Emissions contributions by waste sector activities in Malawi, 2017*

As Figure 8 shows, solid waste disposal made up the largest proportion of emissions in this sector at 82%, followed by wastewater treatment and discharge (16%) from domestic and industrial sources, and burning of waste (2%). The steady increase in waste emissions over time tied to annual population increase could be mitigated by introducing improved waste management systems in Malawi.

## Uncertainty

The IPCC Guidelines provide default percent uncertainty to apply to sectoral emission factors and activity data when available country data does not indicate

uncertainty estimates. Malawi used these percent defaults in all sectors except for forestry, where the Forest Reference Level report from the Department of Forest reports country-specific uncertainty values that are therefore low in uncertainty.

Table 3 *Uncertainty estimates for GHG estimates in Malawi, 2017*

| Energy | IPPU | Waste | Agricultural Soils management (cropland) | Livestock | Forestry |
|---|---|---|---|---|---|
| 9.2% | 9.8% | 86.3% | 196.7% | 36.8% | 1.1% |

IPCC's uncertainty defaults for crops under Tier 1 approach are very high (i.e. 100-200%), rising the overall uncertainty of Malawi's emissions from this sector. Lilongwe University of Agriculture and Natural Resources (LUANAR) is currently developing Tier 2 defaults for Malawi that will decrease uncertainty % for crops and livestock.

Although waste management activities exist in Malawi, the lack of management records led in estimating emissions from waste from population and urbanization proxies, rising the uncertainty of the emissions estimate. With improved data collection systems in place the accuracy of waste emissions estimates is expected to improve.

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**For more information about the GHG-IS and its uses, contact the EAD representative listed below.**

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