



NATIONAL GREENHOUSE GAS INVENTORY SYSTEM OF MALAWI

AGGREGATOR CALCULATOR Standard Operating Procedures



July 2019

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The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

TABLE OF CONTENTS

TABLE OF CONTENTS	1
ACRONYMS AND ABBREVIATIONS	2
1.0 INTRODUCTION	3
2.0 OVERVIEW OF THE AGGREGATOR CALCULATOR	4
3.0 PRODUCING NATIONAL GHG EMISSIONS ESTIMATES USING THE AGGREGATOR CALCULATOR	5
3.1 SECTORAL EMISSIONS INPUT.....	5
3.2 QA/QC & APPROVAL OF EMISSION ESTIMATES.....	6
3.4 REPORTING EMISSIONS	6
1. Uncertainties:.....	6
2. REPORTING FIGURES:.....	6
3.5 UPDATING PIVOT TABLES AND YELLOW TABLES.....	7
Pivot tables.....	7
3 UPDATING DEFAULTS AND EMISSION FACTORS	8
4 EXTERNAL RESOURCES	9

ACRONYMS AND ABBREVIATIONS

AD	Activity Data
EF	Emission Factor
GHG-IS	Greenhouse Gas Inventory System
QA/QC	Quality Assurance/Quality Control
SOP	Standard Operating Procedure
IPCC	Intergovernmental Panel on Climate Change
UNFCCC	United Nations Framework Convention on Climate Change
GWP	Global Warming Potential
CO ₂ e	Carbon Dioxide equivalents
CH ₄	Methane
N ₂ O	Nitrous Oxide
CO ₂	Carbon Dioxide
AR5	Fifth Assessment Report
EAD	Environmental Affairs Department
PERFORM	Protecting Ecosystems and Restoring Forests in Malawi
USAID	United States Agency for International Development
IPPU	Industrial Processes and Product Use sector
AFOLU	Agriculture, Forest, and Other Land Use sector

I.0 INTRODUCTION

The Government of Malawi with USAID’s Protecting Ecosystems and Restoring Forests in Malawi (PERFORM) has developed the Greenhouse Gas Inventory System (GHG-IS) to support Malawi’s Low Emissions Development Strategy. The GHG-IS uses a series of Microsoft Excel emissions calculators that combine methods and data from Intergovernmental Panel on Climate Change (IPCC) Guidelines (2006) with Malawi-specific data to produce estimates of emissions from each sector (see box). These emission calculators are accompanied by Standard Operating Procedures (SOPs) which provide comprehensive guidance on using the calculators.

The Aggregator Calculator compiling annual emissions across sectors in Malawi to produce annual national estimates and trends. Inputs from all sectoral calculators are needed.

This SOP provides comprehensive guidance on the Aggregator Calculator and serves to: (1) provide overview of steps required to operate the Aggregator Calculator; (2) direct analysts through the collection and entry of activity data; and (3) guide the interpretation and reporting of resulting national emission estimates.

Under the GHG-IS, emissions from the energy sector in Malawi are accounted following the Intergovernmental Panel on Climate Change (IPCC) Tier I approach and accounts for emissions resulting from the combustion of fuel to produce energy as well as emissions from surface coal mining,

Sectors accounted for in Malawi’s GHG-IS

Energy: Emissions resulting from production and use of fuels for energy.

Industrial Processes and Product Use: Emissions from producing cement, lime, and ceramics.

Agriculture, Forestry, and other Land Use: Emissions from livestock and agricultural soil management (i.e., fertilizer application), forests remaining forests (degradation from unsustainable fuelwood harvest), and land use change.

Waste: Emissions from wastewater treatment and discharge, incineration and open burning of waste, and solid waste disposal.

referred to as fugitive emissions. The greenhouse gases (GHGs) emitted from these sources include CO₂, CH₄, and N₂O. Only emissions from fuel use and coal production from within Malawi are included, and therefore data on fuel imports and exports are important to complete the accounting of emissions from the energy sector in Malawi.

The main Government entity responsible for the GHG-IS Energy Emissions Calculator is the Environmental Affairs Department (EAD). Personnel responsible for collecting, entering, and analyzing data for the GHG-IS will need to be assigned in accordance with the guidance set forth in the *GHG-IS Master Document* and will need to work with relevant government agencies to collect appropriate data for evaluating emissions from the energy sector.

2.0 OVERVIEW OF THE AGGREGATOR CALCULATOR

The Energy Emissions Calculator is currently built to accommodate data entry and estimate emissions from 2013 to 2040. It includes the following tabs (i.e., Excel worksheets):

Table 1 ENERGY EMISSIONS CALCULATOR TABS

TAB NAME	PURPOSE
Workbook Overview	Provides an overview of the calculator and basic instructions on how to utilize the workbook.
Change Log	Lists of all changes made to the calculator, and documents if they have been QA/QC'ed. The change log must be updated every time the calculator is updated or modified.
Summary by sector	Table compiling all annual emissions by sector and subsector
Summary by IPCC category	Table compiling all annual emissions by IPCC 2006 Guidelines category and subcategories
Uncertainties	Percent uncertainty to apply to each annual emission
Reporting figures	National and sectoral reporting figures
Energy input	Tab where annual emission estimates copied from the Energy (Reference Approach) Calculator need to be pasted on
Waste input	Tab where annual emission estimates copied from the Waste Management Calculator need to be pasted on
Soils input	Tab where annual emission estimates copied from the Managed Agricultural Soils Calculator need to be pasted on
Enteric input	Tab where annual emission estimates copied from the Livestock – Enteric Fermentation Calculator need to be pasted on
Manure input	Tab where annual emission estimates copied from the Livestock – Manure Management Calculator need to be pasted on
Land cover input	Tab where annual emission estimates copied from the Land Cover Change Calculator need to be pasted on
IPPU input	Tab where annual emission estimates copied from the Industrial Processes Calculator need to be pasted on
Fuelwood input	Tab where annual emission estimates copied from the Fuelwood Calculator need to be pasted on
Allsectors_tGas	Automatic compilation of all annual emissions entered on the green tab, organized by IPCC 2006 category, in tons of the original gas (CO ₂ , CH ₄ , or N ₂ O)
Allsectors_tCO₂e	Automatic compilation of all annual emissions entered on the green tab, organized by IPCC 2006 category, in tons of CO ₂ e
Uncertainty calculations	Calculations of percentage uncertainties of activity data and defaults from each sector
Lists	General coefficients used throughout this calculator.

The tabs and tables are color-coded to indicate their function following this key:

Table 2 COLOR KEY FOR TAB AND TABLE FUNCTIONS

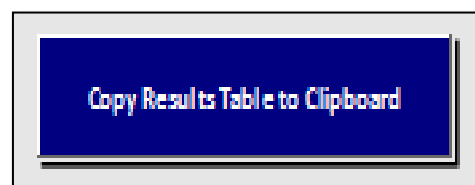
TABLE COLOR	FUNCTION
Orange	Tabs with supporting data and information for the Annual GHG Inventory Report.
Red	Summary results of annual sectoral emissions.
Yellow	QA/QC checks and tables that produce percentage estimates of sub-sectoral emissions
Green	Data entry tabs.
Blue	Intermediary calculations.
Grey	Conversion coefficients

3.0 PRODUCING NATIONAL GHG EMISSIONS ESTIMATES USING THE AGGREGATOR CALCULATOR

Malawi’s GHG-IS is designed to allow for clear and consistent accounting for emissions by limiting data entry in the emissions calculators to activity data in the corresponding sectoral calculators. The annual emissions calculated by these tools can then be entered in the Aggregator Calculator to assess total national emissions and annual trends at the national and the sectoral level for Malawi. The process for collecting, entering, and reviewing those sectoral emissions estimates into the Aggregator Calculator is described below.

3.1 SECTORAL EMISSIONS INPUT

Each GHG-IS sectoral calculator has its corresponding emissions entry tab on the Aggregator Calculator (see Table 1). The results and data to enter on these tabs are those that are automatically copied to the clip board when clicking on the ‘button’ on the Emissions tab of the sectoral calculator.



The copied information should be pasted as instructed in each input tab of the Aggregator Calculator, i.e. by placing the cursor (mouse) in cell B5 of the sectoral input tab, doing right click to select “Paste Special”, and choosing the “values” option (Figure 1). Any other pasting option will carry the original formulas that developed these results on the sectoral calculator and will result in errors on the Aggregator Calculator.

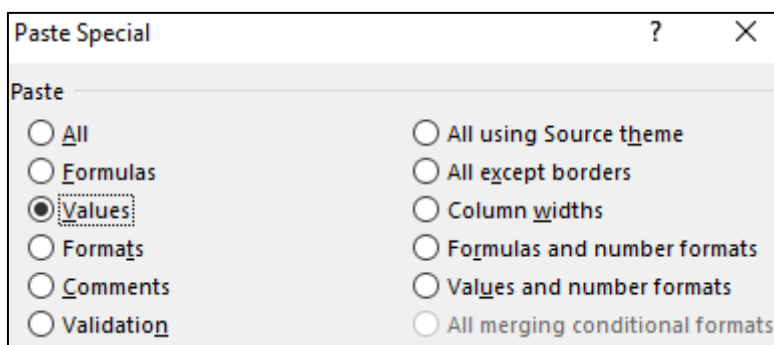


Figure 1. Selecting the option to past values only on excel.

This action will populate the grey tables in each of the input tabs. The Emissions Aggregator Calculator will then automatically create uncertainty estimates and emissions graphs and tables for reporting purposes. These input tabs should be updated yearly, when new annual estimates are developed from each sector.

When the calculator has been updated and/or the input data has been entered, rename the file to be saved file with today's date. **Do not overwrite existing versions**. For example, "Aggregator Emissions Calculator – July_17_2018".

3.2 QA/QC & APPROVAL OF EMISSION ESTIMATES

It is imperative that quality assurance/quality control measures are undertaken to ensure data are correctly entered. The following steps must be followed by the individual responsible for QA/QC every time AD are entered into the Aggregator Calculator.

1. Whenever a change or a series of changes are made to the emissions calculator, review the new version of the workbook by reading entries in the **Change Log** tab.

Figure 2

2. If there are any new changes that have not been reviewed yet, do so considering the following:
 - For all input data tables (grey tables in the green tabs), confirm the values entered for the current year have been correctly entered and are plausible. If a large change is shown since the previous reporting period, make sure that the reason for this difference has been identified and documented in the **Change Log** notes.
 - Follow up with the sectoral focal point to assess the source of change in emissions, such as possible AD entry mistakes or formula corruptions, to ensure the estimates are accurate and realistic. If an error is identified, coordinate with the focal point to obtain corrected sectoral inputs to the Aggregator Calculator.
3. Note in the Change Log tab any comments related to changes that have been QA/QC'd. If any errors were resolved, note the change and set the status to **'OK'd'**.
4. If any errors could not be resolved immediately, change the status to 'needs resolution' while a solution is determined. Seek out the expertise of teammates to resolve unexplained errors. Once resolved, update the change log again for this entry and change status to 'OK'd'.

3.4 REPORTING EMISSIONS

The information necessary for reporting purposes is generated automatically once the sectoral input is entered in each corresponding tab.

The red Summary tabs will show the annual trends by sector and by IPCC category, respectively. They do not require user management, they are merely informational.

The orange tabs provide uncertainty percentages per category and reporting figures, respectively. These are also automatically populated but they are meant to facilitate reporting calculations and values. Therefore, depending on the purpose of the report, they will require interpretation and management by the person or experts responsible for the reporting exercise:

1. **UNCERTAINTIES:** The table on this tab shows the percentages to apply to each sector/IPCC category. For example, if the emissions from cement production at a given year are 30 000 tons CO₂e and the uncertainty of the estimate is 21%, this uncertainty is equivalent to 6 300 tons CO₂e (i.e. 30000 x 21%).
2. **REPORTING FIGURES:** This tab shows numerous graphs and tables that can be used for reporting purposes. Overall, there are 3 types of tables on this tab:

- Orange tables, generated automatically when the reporting year is selected
- Blue and white tables that are “pivot tables”¹ that generate “pivot charts”.
- Yellow tables, pulling data from any of the other two types of tables into a format that might be relevant for reporting purposes (percentages, emissions breakout, etc).

This tab is divided into several sections – a national top section and a set of sectoral sections:

- The top section of the tab shows national emissions by sector for a given year, which is selected on the green cell marked with an “edit->” flag, and annual trends starting on the year selected. Associated graphs populate automatically based on year selection, from the data that gets automatically generated on the orange tables. On the right side of the section there is a pivot table that generates totals per gas for a given year, currently set to 2017 (see instructions below on updating pivot tables). This section also has a couple of yellow tables that calculate corresponding % of each sector or gas, from the data generated on the orange and blue pivot tables.
- The subsequent sections, separated by an orange band indicating the name of the sector, provide a set of pivot tables, pivot charts, and yellow informational tables for AFOLU, Waste, IPPU, Energy, and Fuelwood.

3.5 UPDATING PIVOT TABLES AND YELLOW TABLES

PIVOT TABLES

Pivot tables² are shown with blue table headers and are currently set to show emissions from 2017. To change the year, open the Pivot Table Field by right-clicking on the table and selecting “Show Field List” from the menu (see Figure 2).

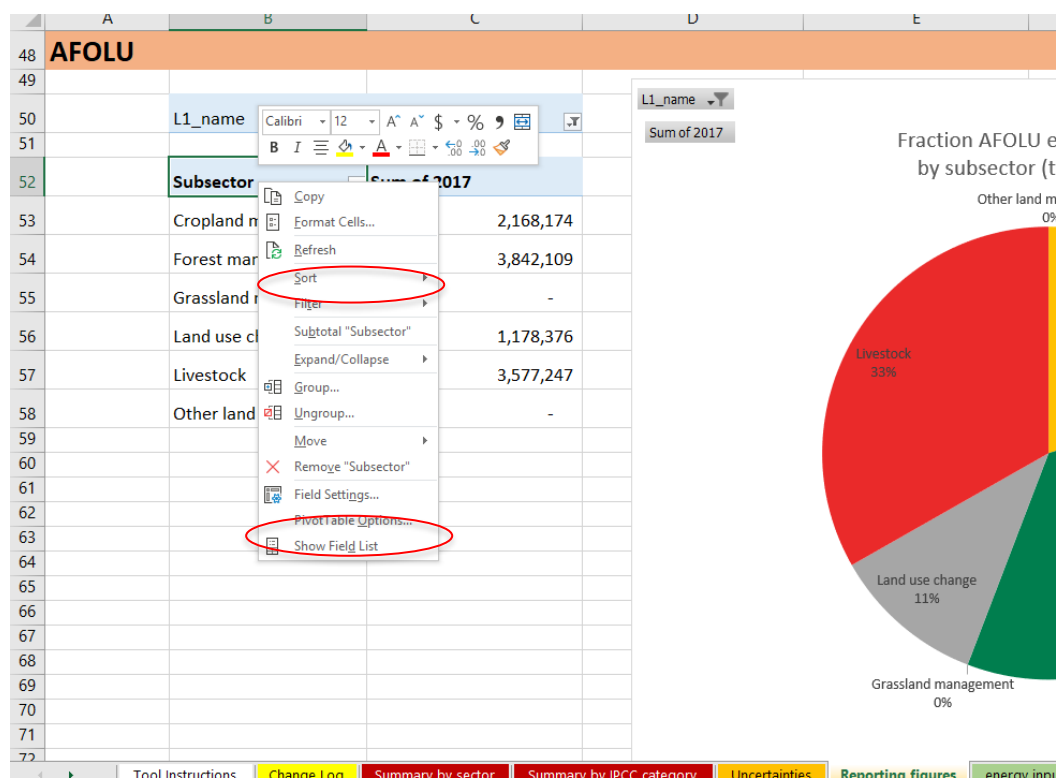


Figure 2 Updating Pivot Tables 'Show Field List' and 'Refresh' location

¹ <https://www.deskbright.com/excel/what-is-a-pivot-table/>

² A **pivot table** is an Excel program that reorganizes and summarizes columns and rows of data in a spreadsheet or database table in a customizable way.

In the menu for each pivot table, choose the desired year and make sure the Value shows “Sum of [year]”(see Figure 3). If ever new data are added to the ‘input’ tables, each pivot table will need to be manually ‘refreshed’ by right-clicking (see Figure 2). When pivot tables are updated, pivot charts must be updated following the same procedure.

Yellow tables pull data from the pivot charts and tabs to produce additional analyses. Many in the Aggregator Tool will show an error if the pivot table is updated (i.e., if the year it is supposed to refer to is not correct). To fix this error, each cell showing errors will need to be edited by clicking on its formula and manually changing the year in quotation marks.

Formula example: `GETPIVOTDATA("2017", V3, "gas", "CH4")`. If the pivot table no longer shows 2017 results, this formula will result in error. The “2017” in the formula needs to be updated to the year selected on the pivot table of interest.

- Note that the year in quotation marks can be present more than once in the formula; all mentions to the year need to be updated accordingly.

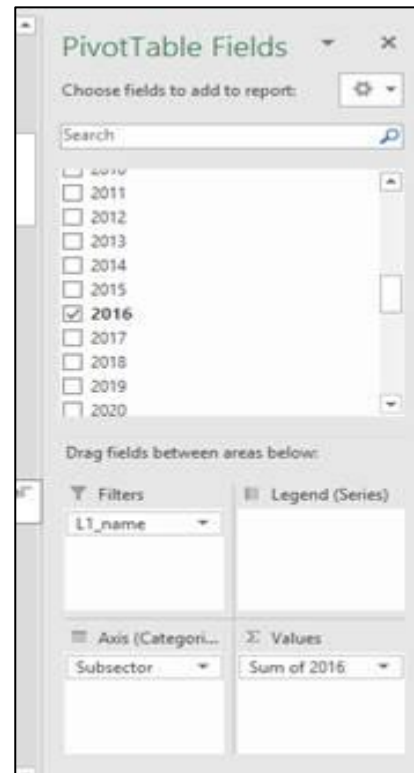


Figure 3. Pivot Table and Pivot Chart Fields

3 UPDATING DEFAULTS AND EMISSION FACTORS

It is not expected that the GHG-IS operators will be responsible for refining or updating default values (global warming potentials) or uncertainty percentages. These are housed on the tabs named “lists” and “Uncertainty calculations”, respectively. However, developments in the availability of information and new research may justify updating coefficients to allow uncertainty estimates to better reflect national circumstances. It not likely that global warming potentials used to convert CH₄ and N₂O emissions into CO₂e will need to be updated, but if necessary, it can be done on the GWP table on the list tab. The process through which uncertainties are updated may involve a combination of expert review, literate review, original research, and comparison to neighboring countries. Guidelines for updating these factors are not provided here. However, in the event that any factors require updating, the following steps should be followed:

1. Directly change the values in the corresponding uncertainty table for the appropriate years.
2. Document any changes in the **Change Log** tab.
3. Deliver any documentation, studies, references etc. that support why the particular change was made to EAD, including a summary of the rationale for the change.

4 EXTERNAL RESOURCES

2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume I Chapter 3. Uncertainties, available at https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/VI_3_Ch3_Uncertainties.pdf.

National Greenhouse Gas Inventory System Of Malawi. Master Document. October 2018.



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