United Nations Institute for Training and Research

Sustainable Cycles (SCYCLE) Programme

PART II - E-waste Generated Tool Manual

- with plastic embedded

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Abbreviations

EEE	: Electrical and electronic equipment
EU-6	: Classification of electrical and electronic equipment under the six categories as set out in Annex III of the Directive 2012/19/EU on WEEE
EU-10	: Classification of electrical and electronic equipment under the ten categories as set out in Annex I of the Directive 2012/19/EU on WEEE
E-WASTE GENERATED	: E-waste generated
POM	: Put on Market
WEEE	: Waste electrical and electronic equipment

1. Introduction

The "E-waste Generated Tool" is an integral part of the methodologies used for the calculation of the weight of electrical and electronic equipment (EEE), Put on Market (POM), and E-waste generated. It is based on the same methodologies as developed by the task group of the E-waste statistics Partnership for Measuring ICT for Development (Balde, 2015).

The E-waste Generated Tools were financed by US EPA and developed by UNU. The Tools are customised for each country in the world except for the countries in the European Union (EU), since they have developed their own. As a result, there are approximately 140 Tools developed on the basis of the same methodology but are pre-populated with data from each country.

The user can utilize the Tool as follows:

1. Search for pre-populated data on Put on Market, lifespans and E-waste generated;
2. Overwrite the pre-populated data of Put on Market, and re-run the calculations with actual data from the country in question; and
3. Provide the calculated data to the UNU with the format of this Tool, and in doing so it collects country information in order to improve future E-waste statistics.

The goal of this manual is to help users to operate, calculate and adapt the data in the Tool and to address possible questions on how the Tool works.

Chapter 2 of this manual presents an overview of the E-waste Generated Tool with the description of its different sheets.

In Chapter 3, the manual provides a guideline to the user on how to operate the Tool in order to perform different tasks.

In Chapter 4, the manual provides an overview of the plastic related sheets to estimate the plastic embedded in the E-waste generated.

The pre-filled data on the quantities of EEE Put on Market (POM) is done using the 'apparent consumption methodology'. The calculation routines have been developed by the United Nations University (UNU), the scripts are based on the Tool developed by Statistics Netherlands (CBS) for Europe, but further developed by UNU for the rest of the world. The methodology used is further described in the E-waste Statistics Guidelines (Forti, 2018) and all the scripts and calculation steps used for the calculations for the EU are published at: https://github.com/Statistics-Netherlands/ewaste.

The E-waste Generated Tool as described in chapter 3.2 can assist the user to insert Put on Market data from national registers in order to calculate relevant quantities of E-waste generated per collection category of EEE as described in Annexes I and III of the EU WEEE Directive 2012/19/EU and recommended in the worldwide guidelines on E-waste statistics developed by the Partnership on Measuring ICT for Development (Forti, 2018).

The methodology to calculate the total quantity of E-waste generated for a specific year and country is based on:

> *The amount of EEE Put on Market (POM) from the preceding years, and for the corresponding product lifespan*.

The Tool includes and uses POM data and product lifespan from 1995 until 2015 in order to facilitate the calculation of E-waste generated starting from 1995 until 2030 as described in chapter 3, sections 3.2 and 3.6.

In order to determine the product lifespan the Tool uses a disposal rate (Weibull distribution) as described in chapter 3.

2. Overview of the E-waste Generated Tool

The E-waste Generated Tool contains a number of different sheets which are essential for the proper functioning of the Tool. Most sheets are hidden by default to prevent accidental changes which will cause wrong calculations.

The table below describes the different sheets that the E-waste Generated Tool contains and explains their purpose:

Table 1: Overview of the sheets of the E-waste Generated Tool

Sheet name	Description/purpose
FrontPage	User interface
Indicators	A table showing a summary of the quantities for each indicator (POM and E-waste generated)
ResultPOM	A table showing the amounts of EEE POM per EU-6 classification
ResultWG	A table showing the amounts of E-waste generated per EU-6 classification
GraphLifespan	A graph illustrating the lifespan of the selected UNU Key
GraphPOM_EU6	A graph illustrating Put on the market data of a specific country in Collection category 6
GraphWG_EU6	A graph illustrating E-waste generated data of a specific country in Collection category 6
POM	A table that can be used to insert a country's Put on Market data
The following sheets are hidden but can be made visible by clicking the "Show sheets" button	
ResultDetail	A table displaying the calculated amounts of E-waste generated per UNU-KEY classification
UNUkeys	A table used to convert the POM input of EU-6 categories into the UNU-KEY
Shape	Shape parameters used for the Weibull distribution for your country (per UNU-KEY)
Scale	Scale parameters used for the Weibull distribution for your country (per UNU-KEY)
Weibull	Used for product lifespan calculations
POM_copy	Copy of the original POM data in the POM sheet. **Do not modify.**
Shape_copy	Copy of the original Shape parameters in the Shape sheet. **Do not modify**.
Scale_Copy	Copy of the original Scale parameters in the Scale sheet. **Do not modify**.
InputEU6	Used for entering POM data based on the EU-6 classification
InputEU6PV	Used for entering POM data based on the EU-6 classification with a separate input for PV panels
InputUNUkey	Used for entering POM data based on the UNU-KEY classification

Do not relocate, insert, or change the individual order of the first seven sheets in the E-waste Generated Tool. This will result in the malfunction of the Show Sheets action button on the "FrontPage".

All other sheets are used for data storage, calculations and intermediate results and **must not** be modified by the user.

The user is allowed to edit the data in the "POM," sheet. The parameters of the lifespan of the product (Weibull distribution) may be edited in the "scale" and "shape" sheets. However, keep in mind that entering an invalid or incorrect parameter will result in incorrect or unexpected results for the amount of E-waste generated. Edited cells in the above-mentioned sheets will be marked in red.

It is recommended to keep the original copy of the E-waste Generated Tool with the default values as a separate file, in case a restore to original settings is needed.

The E-waste Generated Tool is developed in Excel 2010 as an ".xlsm" spreadsheet. It is designed as basic as possible in order to operate across different platforms and is downward compatible to all versions of Excel.

3. Using the E-waste Generated Tool

The "FrontPage" sheet (the first sheet of the E-waste Generated Tool) contains a number of buttons that will allow the user to perform all necessary actions.

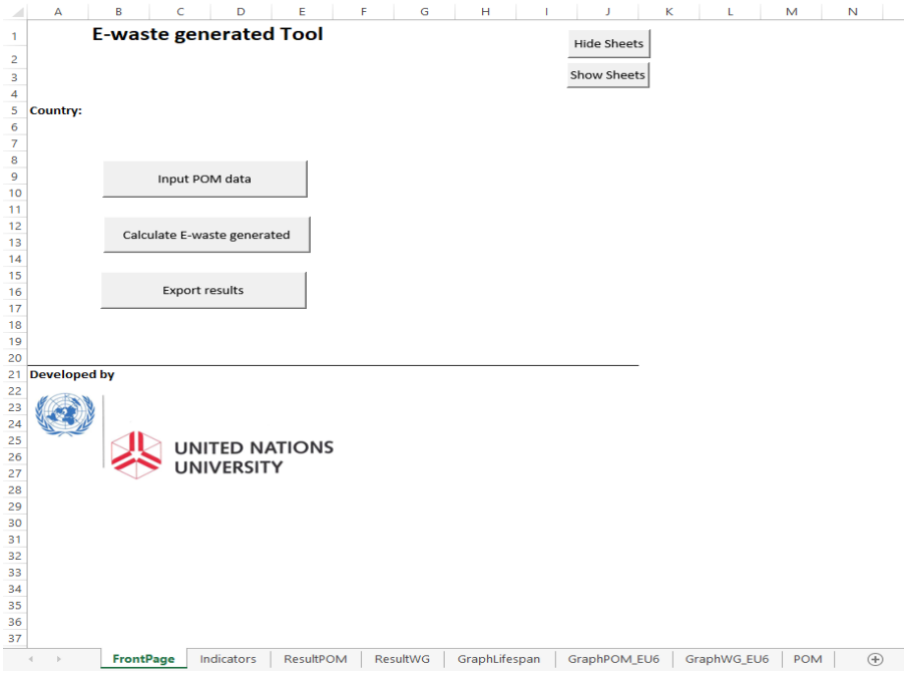

Figure 1 - The "FrontPage" sheet of the E-waste Generated Tool

3.1 Hide/Show sheets

In order to prevent accidental changes to certain sheets, most of them are hidden. However, it is possible to make these sheets visible by clicking on the Show Sheets button. Clicking on the Hide Sheets button will hide the sheets again.

3.2 Enter EEE Put on Market (POM) data

To enter POM data click on the Input POM data button in the "FrontPage" sheet or enter POM data directly in the POM sheet.

When the user clicks on the Input POM data button, the user is asked for the year of the data he would like to feed into the Tool.

Enter the year as a four-digit number (e.g. 2015). Valid years are from 2015 to 2030.

The user will then be requested to choose the preferred type of classification for data entry. The following classifications are available:

1. EU-6 categories: 6 categories of EEE as set out in Annex III of the WEEE Directive 2012/19/EU and in the Statistical Guidelines from the Partnership on Measuring ICT for Development (Baldé, 2015); or
2. UNU categories: 54 categories of EEE developed by the United Nations University (UNU) and defined as 'UNU-KEYs'.

If the user chooses the EU-6 classification, the option of inserting the amount of PV panels individually will be provided. This is highly recommended given the impact of PV panels on Put on Market in recent years.

When entering the data per UNU-KEY, it is necessary to make some calculations in order to convert the data on domestic production into UNU-KEYs. The user should extract the data on the domestic production of EEE by weight reported under the community production system classification (PRODCOM codes) and the Harmonized System Codes (HS Codes).

The E-waste Generated Tool can automatically convert the POM and E-waste generated data on the weight of EEE Put on Market (POM) per UNU-KEY´s into quantities of EEE Put on Market per EU-6. After the selection is done, the sheet for data entry will appear.

The user should enter the EEE POM amounts in tonnes.

If the amount is zero or unknown please enter zero, do not leave the cell empty.

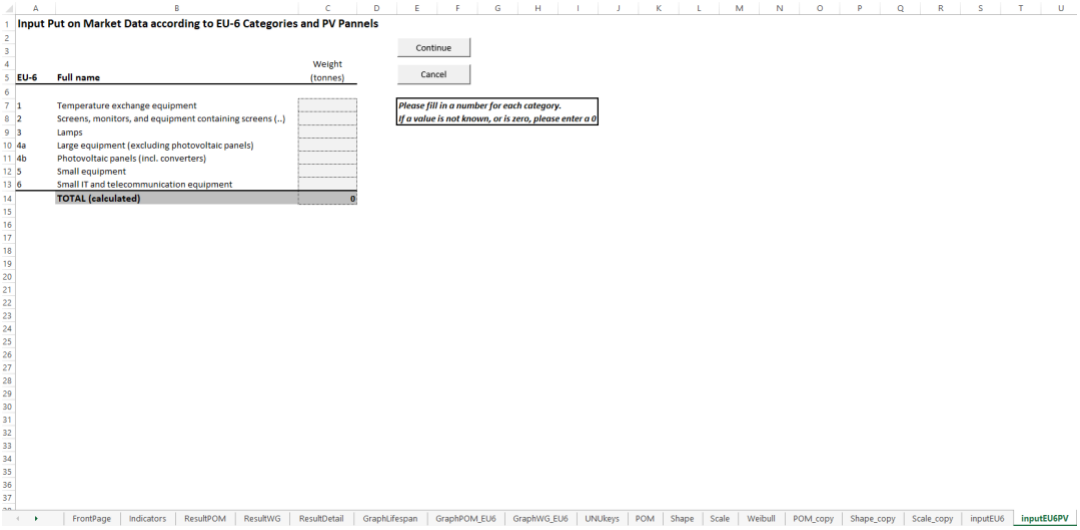

Figure 2 - Example of a POM input sheet using EU-6 + PV Panels classification

To cancel data inputs click on the Cancel button.

To confirm POM data in the E-waste Generated Tool, click on the Continue button. The data is then verified for completeness and valid numbers. If an invalid input is found, the input cells will be highlighted and the user will be required to correct the highlighted cells and press on the Continue button again. If the data is correct, it will be added to the "POM" sheet.

After adding or editing POM data, the calculated amounts of E-waste generated are no longer up to date and need to be re-calculated (see section 3.4 below on how to calculate E-waste generated).

When the user selects to proceed with data entry using the EU-6 categories, the data will be converted into the 54 UNU-KEYs automatically by the E-waste Generated Tool and the data per UNU-KEYs will also be available in the "POM" sheet.

The standard data input is foreseen to be from 2015 until 2030. If the user wishes to modify data prior to 2015, this should be done directly in the "POM" sheet. See also section 3.3 below.

3.3 Enter POM data from a classification other than EU-6

Users of the E-waste Generated Tool might wish to insert POM data from a different classification (for instance a national clustering of products). In such a case, two options are available:

1. National clustering is usually linked to the EU-6 clustering. The first alternative is thus to consolidate the national clustering accordingly and proceed with data entry selecting the EU-6 classification; or

2. National clustering can also be linked to the UNU-KEY classification and data entry could be done at the UNU-KEY level via the button Input POM data for POM data selecting the pop-up window "enter with UNU categories". This ensures better traceability of calculations and results.

Linkage of national clustering to UNU-KEYs can be done by following the basic steps explained below with an illustrated example where IT appliances (cat. 3 in Annex I of the WEEE Directive and in the Statistical Guidelines from the Partnership on Measuring ICT for Development (Baldé, 2015)) are divided into three different categories:

- Each individual category of national clustering should be linked to one or more UNU-KEYs, from the detailed list provided in Annex I, section B.

EU-10	National Clustering	UNU-KEY linked
3	IT Appliances	0301, 0304, 0305, 0306, 0307
	Personal Computer (Desktop, Laptop,...)	0302, 0303
	Screens (CRT, LCD,…)	0308, 0309

- Once the mapping between individual national clustering and UNU-KEYs is done, and data is inserted in the EU-6 classification, individual fractions are calculated in the background on the basis of the latest POM data available for the country in the corresponding sheet: "POM" of the E-waste Generated Tool. This data allows calculating the corresponding share in UNU-KEYs for each individual national cluster.
- The calculated fractions, which as mentioned before are done in the background, are used to break down the national POM data in a UNU-KEY level and this data is saved into the E-waste Generated Tool (hidden ResultDetail sheet) as shown in the example in the table below:

EU-6	National Clustering	Amount national data	UNU-KEY linked	POM data in E-waste generated Tool for 2015	Resulting fractions	Amount national data according to UNU-KEY
2	IT Appliances	5.000t	0301	500t	7,5%	373t
			0304	1.500t	22,4%	1.119t
			0305	1.250t	18,7%	933t
			0306	250t	3,7%	187t
			0307	3.200t	47,8%	2.388t
	Subtotal	**5.000t**		**6.700t**	**100%**	**5.000t**
	Personal Computer (Desktop, Laptop,...)	15.000t	0302	5.500t	37,9%	5.685t
			0303	9.000t	62,1%	9.315t
	Subtotal	**15.000 t**		**14.500t**	**100%**	**15.000t**
	Screens (CRT, LCD,…)	7.500t	0308	2.500t	38,5%	2.888t
			0309	4.000t	61,5%	4.612t
	Subtotal	**7.500t**		**6.500t**	**100%**	**7.500t**

3.4 Calculate E-waste generated

Once the user has entered the POM data for the reference year, the Tool can calculate the quantity of E-waste generated.

The calculation of E-waste generated will start by clicking on the button named Calculate E-waste generated on the "FrontPage" sheet.

The user will then get a notification as soon as the calculations are completed.

The results will then be available on tables on different sheets as described in section 3.5.

3.5 View results

The E-waste Generated Tool shows the results of the POM input, the calculations of the E-waste generated and the summary of the quantities of each indicator per year, as tables (sheets "ResultPOM", and "ResultWG"). Two tables for POM, and E-waste generated in the EU-6 classification will be available.

As graphs, the user can visualize the following sheets: "GraphPOM_EU6", "GraphWG_EU6", etc. as seen in figure 3 below.

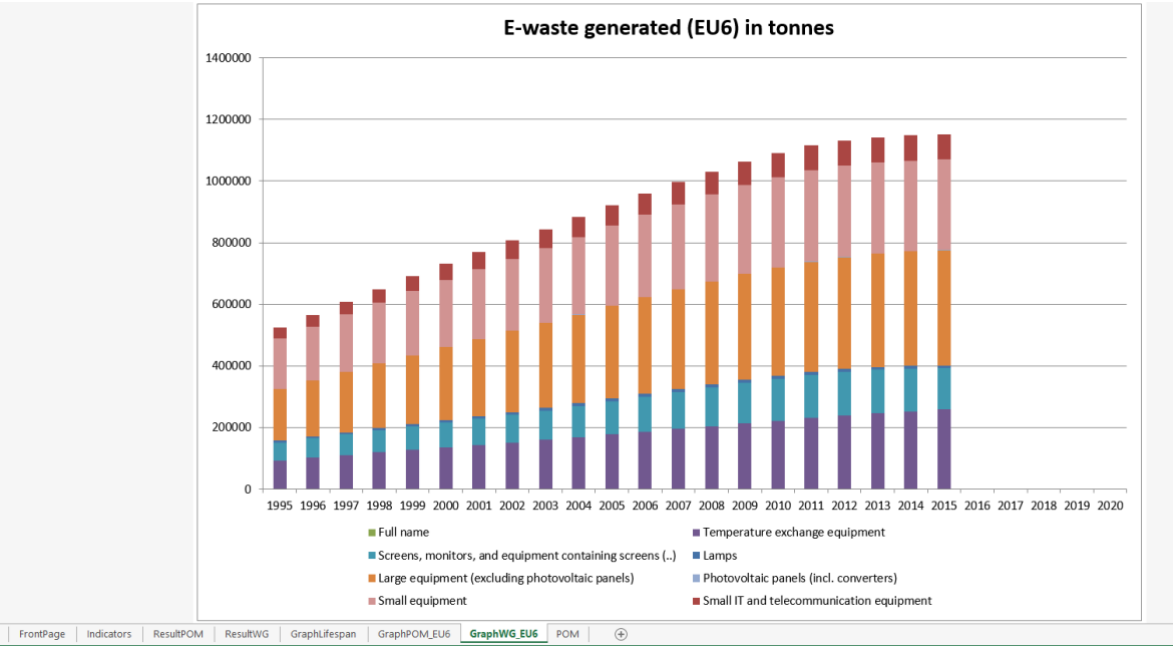

Figure 3– Example of a graph representing E-waste generated for a sample country

3.6 View lifespan graphs

The sheet "GraphLifespan" provides a graphical representation of the lifespan of a selected product group per UNU-KEY.

After selecting a UNU-KEY and a reference year in the corresponding dropdown the graphs will show the percentages (both per year and cumulative) of E-waste generated as well as the average lifespan.

The first graph, as shown in figure 4 below, illustrates the percentage of products Put on Market in the reference year that are being discarded in each of the following years. In this example, it is shown that 6% of the products Put on Market in 2012 will be discarded in 2020. The second graph shows the cumulative amount, expressed as a percentage, of products discarded, showing that by 2030 90% of the products Put on Market in 2012 will be discarded and 10% will still be in use.

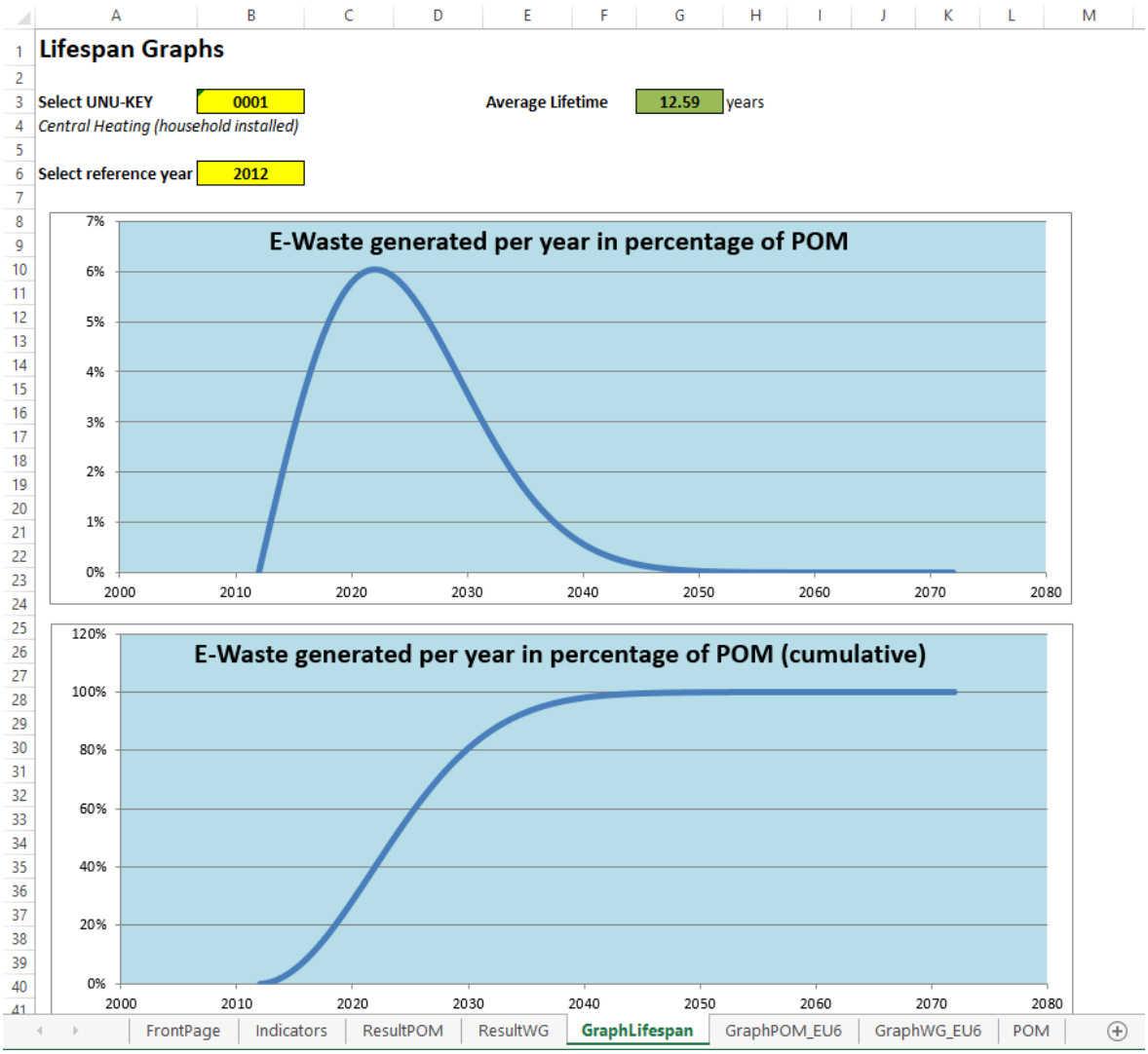

Figure 4– Example of a Lifespan graph

Calculations and data used for the graphs are displayed from cell A50 onwards. The user might check the effects on lifespan and the average lifetime of the *Shape* and *Scale* parameters of the Weibull distribution by editing the parameters in cells A52 and B52. Before selecting another product group (UNU-KEY) or changing the reference year from the dropdown, the user should restore the original values of cells A52 and B52 in the "GraphLifespan" sheet. For a number of UNU-KEYs, the Weibull distribution parameters are the same for every year. Selecting another reference year will, therefore, have no effect on the graphs.

3.7 Export results

The user can Export the results by clicking on the Export Results button on the "FrontPage" sheet. A new spreadsheet will be created and named "Result.xlsx". This filename is fixed and cannot be changed. The spreadsheet will be saved in the same directory where the E-waste Generated Tool is stored.

The following sheets will be exported:

1. Indicators;
2. ResultPOM;

3. ResultWG;
4. GraphLifespan;
5. GraphWG _EU6; and
6. GraphPOM_EU6;

If an Export file already exists, the user will be asked to overwrite it and should then select "Yes".

If the user selects "No" or "Cancel", the Export procedure will be aborted.

If the user wishes to keep an earlier version of the Exported file, then this should be renamed before running the Export functionality again.

4. Plastic related addition to the E-waste Generated Tool

To be able to estimate the plastic embedded in the E-waste generated, the E-waste Generated Tool has some new additions. The new additions include the calculation on the plastic embedded in E-waste generated per EU-6 classification, and the polymer compositions of the plastic embedded in E-waste generated. Plastic related sheets are listed in Table 2 below.

Table 2: Overview of the sheets related to plastic

Sheet name	Description/purpose
Indicators	A table showing a summary of the quantities for each indicator (POM, E-waste generated, and plastic in E-waste generated)
ResultWG	A table showing the amounts of E-waste generated and plastic embedded in E-waste generated per EU-6 classification
ResultbyPolymer	A table presenting the results of polymer composition of plastic embedded in E-waste generated
GraphWG_Plastic_EU6	A graph illustrating plastic embedded in E-waste generated of a specific country in Collection category 6
GraphWG_by polymer	A graph illustrating polymer composition of plastic embedded in E-waste generated of a specific country
The following sheets are hidden but can be made visible by clicking the "Show sheets" button	
PlasticFraction	Plastic fraction parameters representing the percentage of plastic embedded in each UNU-KEY
Polymers	Average polymer composition for EEE sector

All the steps stay the same when using the Tool.

When the calculation is completed, the plastic related results can be found as tables in sheets 'Indicators', 'ResultWG', and 'ResultbyPolymer', and as graphs in sheets 'GraphWG_Plastic_EU6' and 'GraphWG_by polymer'. These plastic related sheets will also be presented in the "Result.xlsx" after clinking the Export Results button on the "FrontPage" sheet.

Annex I: Classifications

A. Classification of EEE under the six categories (EU-6) as set out in Annex III of the WEEE Directive 2012/19/EU and in the Statistical Guidelines from the Partnership on Measuring ICT for Development (Baldé, 2015)

EU-6	Full name
1	Temperature exchange equipment
2	Screens, monitors, and equipment containing screens (...)
3	Lamps
4	Large equipment
5	Small equipment
6	Small IT and telecommunication equipment

B. Classification of EEE under the UNU-KEYs and correlation of UNU-KEYs with the categories under EU-10 and EU-6 classification

UNU-KEY	Description	EEE category under EU-10	EEE category under EU-6
0001	Central Heating (household installed)	1	4
0002	Photovoltaic Panels (incl. inverters)	4	4
0101	Professional Heating & Ventilation (excl. cooling equipment)	1	4
0102	Dishwashers	1	4
0103	Kitchen equipment (e.g. large furnaces, ovens, cooking equipment)	1	4
0104	Washing Machines (incl. combined dryers)	1	4
0105	Dryers (wash dryers, centrifuges)	1	4
0106	Household Heating & Ventilation (e.g. hoods, ventilators, space heaters)	1	4
0108	Fridges (incl. combi-fridges)	1	1
0109	Freezers	1	1
0111	Air Conditioners (household installed and portable)	1	1
0112	Other Cooling equipment (e.g. dehumidifiers, heat pump dryers)	1	1
0113	Professional Cooling equipment (e.g. large air conditioners, cooling displays)	1	1
0114	Microwaves (incl. combined, excl. grills)	1	5
0201	Other small household equipment (e.g. small ventilators, irons, clocks, adapters)	2	5

UNU-KEY	Description	EEE category under EU-10	EEE category under EU-6
0202	Equipment for food preparation(e.g. toaster, grills, food processing, frying pans)	2	5
0203	Small household equipment for hot water preparation (e.g. coffee, tea, water cookers)	2	5
0204	Vacuum Cleaners (excl. professional)	2	5
0205	Personal Care equipment(e.g. toothbrushes, hair dryers, razors)	2	5
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	3	6
0302	Desktop PCs (excl. monitors, accessoires)	3	6
0303	Laptops (incl. tablets)	3	2
0304	Printers (e.g. scanners, multi functionals, faxes)	3	6
0305	Telecommunication equipment (e.g. (cordless) phones, answering machines)	3	6
0306	Mobile Phones (incl. smartphones, pagers)	3	6
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	3	4
0308	Cathode Ray Tube Monitors	3	2
0309	Flat Display Panel Monitors (LCD, LED)	3	2
0401	Small Consumer Electronics (e.g. headphones, remote controls)	4	5
0402	Portable Audio & Video (e.g. MP3, e-readers, car navigation)	4	5
0403	Music Instruments, Radio, Hi-Fi (incl. audio sets)	4	5
0404	Video (e.g. Video recorders, DVD, Blue Ray, set-top boxes) and projectors	4	5
0405	Speakers	4	5
0406	Cameras (e.g. camcorders, photo & digital still cameras)	4	5
0407	Cathode Ray Tube TVs	4	2
0408	Flat Display Panel TVs (LCD, LED, Plasma)	4	2
0501	Small lighting equipment (excl. LED & incandescent)	5	5
0502	Compact Fluorescent Lamps (incl. retrofit & non-retrofit)	5	3
0503	Straight Tube Fluorescent Lamps	5	3
0504	Special Lamps (e.g. professional mercury, high & low-pressure sodium)	5	3

UNU-KEY	Description	EEE category under EU-10	EEE category under EU-6
0505	LED Lamps (incl. retrofit LED lamps)	5	3
0506	Household Luminaires (incl. household incandescent fittings & household LED luminaires)	5	5
0507	Professional Luminaires (offices, public space, industry)	5	5
0601	Household Tools (e.g. drills, saws, high-pressure cleaners, lawn mowers)	6	5
0602	Professional Tools (e.g. for welding, soldering, milling)	6	4
0701	Toys (e.g. car racing sets, electric trains, music toys, biking computers, drones)	7	5
0702	Game Consoles	7	6
0703	Leisure equipment (e.g. sports equipment, electric bikes, juke boxes)	7	4
0801	Household Medical equipment(e.g. thermometers, blood pressure meters)	8	5
0802	Professional Medical equipment (e.g. hospital, dentist, diagnostics)	8	4
0901	Household Monitoring & Control equipment (alarm, heat, smoke, excl. screens)	9	5
0902	Professional Monitoring & Control equipment (e.g. laboratory, control panels)	9	4
1001	Non- cooled Dispensers (e.g. for vending, hot drinks, tickets, money)	10	4
1002	Cooled Dispensers (e.g. for vending, cold drinks)	10	1