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Monitoring Export for Reuse in the Netherlands

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Introduction

This monitoring plan provides a summary of the methods and results of “**export for reuse**” extracted from the on-going study called “*The Dutch WEEE flows 2020, What happened between 2010 and 2018*”. The project has been conducted by United Nations University SCYCLE, in cooperation with FFACT and it was commissioned by the NVMP. The report quantifies the entire Dutch WEEE (Waste Electrical and Electronic Equipment) flows for the year 2018. The report presents the EEE Placed on the Market (POM), WEEE generated, the compliantly regulated WEEE collection, and the (W)EEE flows outside the regulated WEEE management system in the Netherlands, including the export for reuse. The methodologies are based on the report of the Dutch WEEE flows from 2011, that quantified the flows for the year 2010¹.

In the Dutch WEEE flows study from 2012, the export for reuse has been quantified for the reference year 2010. The methodology for export for reuse was based on visual inspections, although other methods were also used to cross check the validity of the data point. The methodology and the results (44 kton) were therefore not transferable to assess exports for reuse in 2018. In the meantime, the National WEEE Register started to monitor exports for reuse through a voluntary registration. Data from the National WEEE Register is available for 2017 and 2018. As this registration is still in the pilot phase and there is limited information, other methods to assess the exports for reuse were used to cross check the data in the National WEEE Register. It appears that the 2017 and 2018 data in the National WEEE Register is not complete. Consequently, the aim was to calculate an improved figure on the exported tonnages EEE for reuse.

There was not one data source that covers the exports for reuse entirely for all products. Therefore, the following six methods and data sources have been used. A conservative estimation approach has been taken to ensure higher certainty that the products are indeed exported. The six data sources / methods were:

- 1) The National WEEE Register
- 2) Desktop research of recently conducted studies
- 3) Trade data price analysis: export of mixed new and used electrical and electronic equipment
- 4) Trade data: used electrical and electronic equipment exported in vehicles
- 5) Expert guess of the reusability per UNU-KEY
- 6) Data from LUCA test center

The outcomes per method were compared per UNU-KEY. Then the outcomes of the best method per UNU-KEY was chosen, and it was ensured that no double counting took place. This is explained in chapter 7 (integration of data). The outcomes are in line with the overall results of the Dutch WEEE Flows study 2020.

¹ The Dutch WEEE Flows, 2010.

<https://www.nvmp.nl/uploads/pdf/nieuws/2012/raportfuture/Report%20The%20Dutch%20WEEE%20Flows.pdf>

Method 1: The National WEEE Register (high quality)

1.1 Data sources and data collection

The National WEEE Register (NWR) did a pilot for registration by producers of Export for Reuse in 2017 and in 2018. The results are included in the report “Rapportage over 2018”.

1.2 Method

The data from the NWR was obtained in the categories of the National WEEE Register. It had to be converted into the UNU-KEYs. The following conversions were done:

Category 2 was completely allocated to 0204, vacuum cleaner. This allocated might have to be refined in the future, if more weight is reported in this category. In 2018, only 114 kg was reported.

Category 3b (IT- en telecom apparatuur – flatpanels), has been allocated to UNU-KEY 0309 (Flat Display Panel Monitors (LCD, LED)). The breakdown of category 3c (IT- en telecom apparatuur - overig huishoudelijk) into the UNU-KEYs was done with the UNU-KEY fractions in mass% obtained from method 2, and is shown below.

UNU-KEY	Description	Fraction
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	98,864%
0302	Desktop PCs (excl. monitors, accessoires)	1,037%
0303	Laptops (incl. tablets)	0,091%
0304	Printers (e.g. scanners, multi functionals, faxes)	0,000%
0305	Telecommunication equipment (e.g. (cordless) phones, answering machines)	0,000%
0306	Mobile Phones (incl. smartphones, pagers)	0,009%

Table 1: UNU-KEY fractions in mass% obtained from method 2.

Category 3d (IT- en telecom apparatuur - overig professioneel) was allocated to UNU-KEY 0307 (Professional IT equipment (e.g. servers, routers, data storage, copiers)). Category 6 was completely allocated to professional tools UNU-KEY 0602, as it was suspected that reuse would occur most for professional tools, and in a lesser extend for household tools (UNU-KEY 0601). Category 10b (Automaten – ongekoeld) was allocated to UNU-KEY 1001 (non-cooled dispensers).

1.3 Results

The data from the NWR was provided to the United Nations University shown below:

Cat.	Description	kton
2	Klein Huishoudelijk	0,000114
3b	IT- en telecom apparatuur - flatpanels	0,222707
3c	IT- en telecom apparatuur - overig huishoudelijk	0,120643
3d	IT- en telecom apparatuur - overig professioneel	2,652934
9	Tools	1,280
10b	Automaten - ongekoeld	0,110670

The converted data into the UNU-KEYs is shown below:

UNU-KEY	Description	NWR (kton)
0204	Vacuum Cleaners (excl. professional)	0,000114
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	0,12
0302	Desktop PCs (excl. monitors, accessoires)	0,00125
0303	Laptops (incl. tablets)	0,00011
0306	Mobile Phones (incl. smartphones, pagers)	0,00001
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	2,65
0309	Flat Display Panel Monitors (LCD, LED)	0,222707
0602	Professional Tools (e.g. for welding, soldering, milling)	0,00128
1001	Non- cooled Dispensers (e.g. for vending, hot drinks, tickets, money)	0,111
Total		3,108

Table 2: Conversion of the NWR Data in the UNU-KEYs

Method 2: Desktop research of previous studies (*high quality*)

2.1 Data sources and data collection

- A study on data center equipment (AmEcBoard, 2018), using market information provided by Dutch data centers, recyclers and refurbishers;
- Research on export for reuse of professional electronics (RTA/ICTM, 2019), using market information provided by partners in several Dutch producer responsibility schemes (producers, traders, recyclers, refurbishers);

Both studies potentially show overlap with NWR pilot registrations from method 1.

2.2 Method

The methodology is described in detail in the report “circulaire dataservers” from FFACT.² The selected enterprises have received a questionnaire, and additional information was received from 14 follow-up interviews. The quality of the responses sometimes had to be supplemented with assumptions and estimations. The assumptions and estimations were tested with experts.

2.3 Results

The outcomes were copied from the internal reports.

UNU-KEY	Description	kton
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	3,09
0302	Desktop PCs (excl. monitors, accessoires)	0,0324
0303	Laptops (incl. tablets)	0,0028
0306	Mobile Phones (incl. smartphones, pagers)	0,0003
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	4,81
	Total	7,9355

Method 3: Trade data price analysis: export of mixed new and used electrical and electronic equipment (*medium quality*)

3.1 Data sources and data collection

A query was made in Eurostat (the statistical office of the European Union) database on trade statistics. Data in Eurostat is reported in the Combined Nomenclature (CN), the EU's eight-digit coding system, comprising the Harmonized System (HS) codes with further EU subdivisions. The Eurostat international trade website can be accessed [here](#).

Step 1 is the selection of data for different dimensions.

1. “Reporter” (the exporting country): “NL- Netherlands”
2. “Flow” (import or export): “export”
3. “Partner”: here all partners were selected except for the codes for the European Union (EU28) and the no data codes (ZZ-NO Data).
4. “Period”: yearly data was selected (code 52) for 2010 – 2018.
5. “Product”: United Nations University converted the 54 UNU Keys to CN Codes. The 783 linked CN codes were selected in the query. All the CN codes

² Circulaire Dataservers, FFACT, juni 2018. <https://www.nldigital.nl/wp-content/uploads/2018/07/Circulaire-Dataservers-Rapport-2018.pdf>

linked to the UNU Keys can be found in the supplementary information excel file.

6. "Indicators": "value in euros", "quantity in 100KG", "supplementary quantity"

Step 2 is the lay out selection.

1. "Slice": Codes and Labels
2. "Rows": dimension 1: products (format Labels), Dimension 2 : Period (format labels), dimension 3 : flow (format codes and labels), dimension 4 : partners (format codes), Dimension 5 : Reporter (format codes).
3. Columns : Dimension 1 : Indicators.

Step 3 is the output selection.

Output was generated in excel, empty rows, columns and tables were removed and the query was saved.

In future, the same data can be downloaded from the database from Statistics Netherlands. This data is usually published a few months earlier.

3.2 Method

Data conversion

In addition, "supplementary quantities" and "Quantity in 100 KG" of lower than 2 were removed as this is likely to contain errors. The UNU Keys (linked to the CN codes), European Union Collection categories and the UN regions were added to the file. An overview of the UN Regions and CN code descriptions can be found in the excel supplementary information. Seventeen small countries did not have a conversion code to the UN regions, these were added manually. The files were divided per year from 2010 to 2018.

Price analysis

In Eurostat, the trade data on electrical and electronic equipment (EEE) can include new and used products. The first step was to calculate the average price per piece (per product). The data was also reviewed for outliers, such as prices of more than €100.000,00 and less then €0,10 (of which the product descriptions were reviewed). It can also be considered to calculate the average weight per piece as an additional validation step. Although, this step is not per se necessary for the analysis, costs additional time, but could increase the quality of the outcomes.

The second step was to analyze the prices. Then the median price of the average price per UNU-KEY was calculated for each year. The median was used instead of the mean, because outliers and skewed data have a smaller effect on the median than on the mean. The consistency between the years was also cross checked, and corrected where needed. Please note that the median price was not calculated per CN code, it would cost a lot of resources to create consistent time series all 784 CN for the 2010-2018 time series.

UNU Key 0301 and 0405 were excluded because of the wide range of (small) products. The lamps (UNU-KEY 0501 to 0507) are also excluded from the analysis.

A review was made of the median per UNU Key for the years 2010 – 2018, and the underlying data of the outliers were reviewed and adjusted. Secondly, all products

with a price of 30% of the median price were selected. For example, kitchen equipment (such as furnaces and ovens) had a median export price of €230,00 in 2018. All products with 30% of this price, a price of €69,00 or less, were assumed to be used-EEE exports.

Only for category 6 (Small IT) of the WEEE Directive 10% per UNU key was selected because we expected that the price variation was larger, and therefore, for precautionary principle, a lower percentage was used.

10% to 30% of the median of the price per UNU Key is a relatively low price for used equipment. There could be more second-hand products in reality. However, at this level of detail, reporting errors in the records of the trade statistics are also likely to be present. This lower share was chosen so that there is more certainty that the data are actually used-EEE exports.

Finally, the total weight of the products with a price lower than 30% of the UNU Key were summed up for the following regions Africa, Asia (including the Middle East), Eastern Europe, Central and South America and Polynesia/ Melanesia, as literature shows there is higher export of used products to these regions.

Per analysed data point (year, trade from Netherlands to another country, UNU-KEY) the exports are probably a mix of new and used equipment. By using a conservative method (30% or 10% of the median price) was used as a threshold.

The method leads to both under coverage, and over coverage of the data. Since the price new units weight in larger in the price, the effect of under coverage is more likely with the ratio of 30% of the new price. See both examples:

Unfortunately, it is currently not known, and depends per appliance and country what the ratio of new vs second hand EEE imports is. Therefore, the chosen threshold remains an expert guess.

Example 1 – under coverage:

Reality:

New price = 100 EUR, threshold = 30 Euro

20 laptops – new 100 Euro / unit = 2'000 EUR

130 laptops – used 20 Euro / unit = 2'600 EUR

What is recorded is the average of both shipments: Price = $3000/70 = 31$ EURO / unit

This would not be counted as used-EEE, whereas the majority is used-EEE, leading to an under coverage of 130 units.

Example 2 – over coverage:

Reality:

New price = 100 EUR, threshold = 30 Euro

20 laptops – new 100 Euro / unit = 2'000 EUR

200 laptops – used 20 Euro / unit = 4'000 EUR

What is recorded is the average of both shipments: Price = $6000/220 = 27$ EURO / unit

This would be counted as used-EEE, and 20 laptops are 'over- covered', which is 10% of the total.

3.3 Results

An overview of the median price per unit per UNU Key, per year can be found in the supplementary information excel file. The weight was aggregated into the six European collection categories.

Table 3 presents the results overall export per year in kton per European category. In the supplementary information excel file a table with the results per UNU Key is shown. The UNU KEYS were added to the data in the conversion step. The results of the years 2010 to 2018 were compared, the years 2011, 2013-2015 show relatively higher export, but the years 2010, 2012 and 2016-2018 show similar results. Those higher outcomes (marked in yellow) are probably outliers, but no further investigation / finetuning has been performed to smoothen out the time series.

The median values of 2018 did not contain outliers, thus the outcomes are expected not be outliers too.

Year/Category	1*	2*	3*	4a*	4b	5*	6
2010	0,707	0,307		1,351		5,919	3,888
2011	3,469	9,852		4,734		4,954	0,853
2012	0,723	0,220		0,873		6,261	0,225
2013	2,574	16,494		0,000		22,490	16,484
2014	3,496	0,590		35,130		9,419	5,954
2015	10,073	9,636		0,000		26,891	3,194
2016	0,703	1,674		2,195		4,937	0,161
2017	0,455	2,142		0,218		2,709	2,976
2018	0,324	2,684		2,743		2,321	4,344

*Cat 1-5: 30% median

*Cat 6: 10% median

Table 3: Total export of UEEE in the 6 categories of the WEEE Directive, per year based on Eurostat price analysis (in kton). Items marked in yellow are probably outliers.

The data per UNU-KEY for 2018 is shown below:

UNU-KEY	Description	Exports for reuse (kton)
0101	Professional Heating & Ventilation (excl. cooling equipment)	0,0006
0102	Dishwashers	0,0624
0104	Washing Machines (incl. combined dryers)	0,0106
0106	Household Heating & Ventilation (e.g. hoods, ventilators, space heaters)	0,0186
0108	Fridges (incl. combi-fridges)	0,0654
0109	Freezers	0,0121
0113	Professional Cooling equipment (e.g. large air conditioners, cooling displays)	0,2468
0114	Microwaves (incl. combined, excl. grills)	0,001

0201	Other small household equipment (e.g. small ventilators, irons, clocks, adapters)	0,1993
0202	Equipment for food preparation(e.g. toaster, grills, food processing, frying pans)	0,0138
0203	Small household equipment for hot water preparation (e.g. coffee, tea, water cookers)	0,9526
0204	Vacuum Cleaners (excl. professional)	0,145
0205	Personal Care equipment(e.g. tooth brushes, hair dryers, razors)	0,0026
0302	Desktop PCs (excl. monitors, accessoires)	2,2984
0303	Laptops (incl. tablets)	0,0309
0304	Printers (e.g. scanners, multi functionals, faxes)	0,0518
0305	Telecommunication equipment (e.g. (cordless) phones, answering machines)	1,5888
0306	Mobile Phones (incl. smartphones, pagers)	0,4046
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	2,6275
0308	Cathode Ray Tube Monitors	0,0076
0309	Flat Display Panel Monitors (LCD, LED)	2,5961
0402	Portable Audio & Video (e.g. MP3, e-readers, car navigation)	0,0115
0403	Music Instruments, Radio, Hi-Fi (incl. audio sets)	0,4324
0404	Video (e.g. Video recorders, DVD, Blue Ray, set-top boxes) and projectors	0,2505
0406	Cameras (e.g. camcorders, photo & digital still cameras)	0,1082
0407	Cathode Ray Tube TVs	0,0176
0408	Flat Display Panel TVs (LCD, LED, Plasma)	0,0314
0601	Household Tools (e.g. drills, saws, high pressure cleaners, lawn mowers)	0,0003
0703	Leisure equipment (e.g. sports equipment, electric bikes, juke boxes)	0,0121
0901	Household Monitoring & Control equipment (alarm, heat, smoke, excl. screens)	0,2039
0902	Professional Monitoring & Control equipment (e.g. laboratory, control panels)	0,0086
1001	Non- cooled Dispensers (e.g. for vending, hot drinks, tickets, money)	0,0024
	Total	12,4154

Method 4: Trade data: used electrical and electronic equipment exported in vehicles (*medium quality*)

4.1 Data sources and data collection

The fourth method is based on the study “Person in the Port” project.³ The actual “person in the port” inspected in Nigeria in 2015 and in 2016 the content of containers, vehicles and import documents of used electronics. From these inspections it was found that 49% of the cars contained used electronics, with an average used content of 220 kg, 56% of the buses contained used electrical and electronic equipment, with a used-EEE content of 500 kg and 68% of the trucks contained used electrical and electronic equipment, with an average content of 1560 kg. See table below.

³ Person in the Port Project, 2017. https://collections.unu.edu/eserv/UNU:6349/PiP_Report.pdf

Vehicle Types	Vehicles with UEEE	Average UEEE content per vehicle (kg)
Cars	49%	220
Buses	56%	500
Trucks	68%	1560

Table 4: Percentages of vehicles and weight of UEEE from UNU's Person in Port report.

Data was downloaded from Eurostat using the same approach as in method 3. from the Netherlands to different dimensions.

1. "Reporter" (the exporting country): "NL- Netherlands"
2. "Flow" (import or export): "export"
3. "Partner": Nigeria and its neighboring countries: Benin, Cameroon, Ghana and Togo.
4. "Period": yearly data was selected (code 52) for 2010 and 2015-2018.
5. "Product": In EUROSTAT there are specific CN codes on used vehicles (cars, trucks and busses). See Table 4.
6. "Indicators": "value in euros", "quantity in 100KG", "supplementary quantity"

The "lay-out" and "output" selection in Eurostat were the same as in method 3.

Cars	Trucks	Bus
Motor cars and other motor vehicles principally designed for the transport of persons (other than those of heading 8702), including station wagons and racing cars	Motor vehicles for the transport of goods	Motor vehicles for the transport of ten or more persons, including the driver
Used 87032190 87032290 87032390 87032490 87033190 87033290 87033390 87034090 87036090 87038090	Used 87042139 87042199 87042299 87042399 87043139 87043199 87043299	Used 87021019 87021099 87029019 87029039

Table 4: CN codes of used vehicles

4.2 Method

The percentages of vehicles with UEEE (49% cars, 56% buses and 68% trucks) were applied to the total number of pieces exported. The number of vehicles with UEEE were multiplied with the average UEEE content per vehicle. The Person in the Port Project also listed the categories of products. The categories listed in the report were linked to the relevant UNU-KEYS and 6 categories in the WEEE Directive. An overview of these conversion tables can be found in the supplementary information excel file.

4.3 Results

Table 4 presents the total export of UEEE in vehicles per year.

Year	Total UEEE kton	EU 1 (17%)	EU 2 (35%)	EU 3	EU 4a (19%)	EU 4b	EU 5 (16.7 %)	EU 6 (12.3%)
2010	11,0	1,9	3,9		2,1		1,8	1,4
2011	12,6	2,1	4,4		2,4		2,1	1,6
2012	12,5	2,1	4,4		2,4		2,1	1,5
2013	15,4	2,6	5,4		2,9		2,6	1,9
2014	8,0	1,4	2,8		1,5		1,3	1,0
2015	7,1	1,2	2,5		1,3		1,2	0,9
2016	4,9	0,8	1,7		0,9		0,8	0,6
2017	4,4	0,7	1,5		0,8		0,7	0,5
2018	4,7	0,8	1,7		0,9		0,8	0,6

Table 5: Total export of UEEE in vehicles in the 6 categories of the WEEE Directive, per year based on EUROSTAT Analysis (in kton)

The data per UNU-KEY is shown below:

UNU-KEY	Description	kton
0104	Washing Machines (incl. combined dryers)	0,282
0108	Fridges (incl. combi-fridges)	0,517
0111	Air Conditioners (household installed and portable)	0,282
0114	Microwaves (incl. combined, excl. grills)	0,188
0203	Small household equipment for hot water preparation (e.g. coffee, tea, water cookers)	0,0188
0302	Desktop PCs (excl. monitors, accessories)	0,329
0303	Laptops (incl. tablets)	0,141
0304	Printers (e.g. scanners, multi functionals, faxes)	0,235
0306	Mobile Phones (incl. smartphones, pagers)	0,0141
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	0,611
0309	Flat Display Panel Monitors (LCD, LED)	0,846
0403	Music Instruments, Radio, Hi-Fi (incl. audio sets)	0,0752
0404	Video (e.g. Video recorders, DVD, Blue Ray, set-top boxes) and projectors	0,188
0405	Speakers	0,2867
0407	Cathode Ray Tube TVs	0,658
	Total	4,6718

Method 5: Expert guess of the reusability per UNU-KEY (low quality):

5.1 Data

Several data sources are needed to perform this method:

- WEEE Generated per UNU-KEY.
- WEEE Collected in NWR (per UNU-KEY)
- WEEE in Waste Bin (per UNU-KEY)

Based on an expert judgement it was decided which UNU Keys are likely to be exported for re-use.

5.2 Methods

As a first step, the UNU-KEYs were grouped into three likelihoods considering export for reuse: small likelihood, medium likelihood, high likelihood. All UNU-KEYs with a small likelihood were excluded from the further analysis. Then, three estimations were made for all medium and high likelihood exports. In this step, a low, mid or high fraction is chosen, as shown below. These percentages applied to the gap of WEEE (GAP = WEEE Generated – WEEE collected – WEEE in the waste bin).

UNU-KEY	Description	Perc. (low)	Perc. Mid	Perc. (high)
0108	Fridges (incl. combi-fridges)	10%	15%	20%
0109	Freezers	10%	15%	20%
0113	Professional Cooling equipment (e.g. large air conditioners, cooling displays)	20%	30%	40%
0114	Microwaves (incl. combined, excl. grills)	10%	15%	20%
0202	Equipment for food preparation(e.g. toaster, grills, food processing, frying pans)	10%	15%	20%
0204	Vacuum Cleaners (excl. professional)	10%	15%	20%
0205	Personal Care equipment(e.g. tooth brushes, hair dryers, razors)	10%	15%	20%
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	20%	30%	40%
0302	Desktop PCs (excl. monitors, accessoires)	20%	30%	40%
0303	Laptops (incl. tablets)	20%	30%	40%
0304	Printers (e.g. scanners, multi functionals, faxes)	20%	30%	40%
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	20%	30%	40%
0308	Cathode Ray Tube Monitors	20%	30%	40%
0309	Flat Display Panel Monitors (LCD, LED)	20%	30%	40%
0407	Cathode Ray Tube TVs	20%	30%	40%
0602	Professional Tools (e.g. for welding, soldering, milling)	10%	15%	20%
0802	Professional Medical equipment (e.g. hospital, dentist, diagnostics)	10%	15%	20%

0902	Professional Monitoring & Control equipment (e.g. laboratory, control panels)	20%	30%	40%
1001	Non- cooled Dispensers (e.g. for vending, hot drinks, tickets, money)	20%	30%	40%
1002	Cooled Dispensers (e.g. for vending, cold drinks)	20%	30%	40%

Table 6: The model parameters for the UNU-KEYS to be exported for reuse.

5.3 Results

The gap per UNU-KEY was positive for all selected UNU-KEYs, as described in section 5.2, except for UNU-KEY 1001 (non-cooled dispensers). Therefore, UNU-KEY 1001 is omitted from the results. The percentage was subjected to the gap and yielded in the following numbers.

UNU-KEY	Name	Export for reuse (kt) - Low	Export for reuse (kt) - Mid	Export for reuse (kt) - High
0108	Fridges (incl. combi-fridges)	1,4	2,2	2,9
0109	Freezers	1,1	1,6	2,2
0113	Professional Cooling equipment (e.g. large air conditioners, cooling displays)	1,1	1,6	2,2
0114	Microwaves (incl. combined, excl. grills)	0,7	1,1	1,5
0202	Equipment for food preparation(e.g. toaster, grills, food processing, frying pans)	0,3	0,5	0,7
0204	Vacuum Cleaners (excl. professional)	0,2	0,3	0,3
0205	Personal Care equipment(e.g. tooth brushes, hair dryers, razors)	0,2	0,3	0,5
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	0,4	0,5	0,7
0302	Desktop PCs (excl. monitors, accessoires)	1,1	1,6	2,2
0303	Laptops (incl. tablets)	0,5	0,8	1,1
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	2,2	3,2	4,3
0308	Cathode Ray Tube Monitors	0,9	1,4	1,8
0309	Flat Display Panel Monitors (LCD, LED)	0,9	1,3	1,8
0407	Cathode Ray Tube TVs	0,6	0,8	1,1
0602	Professional Tools (e.g. for welding, soldering, milling)	0,1	0,1	0,1
0802	Professional Medical equipment (e.g. hospital, dentist, diagnostics)	0,3	0,4	0,6
0902	Professional Monitoring & Control equipment (e.g. laboratory, control panels)	0,7	1,0	1,3
1002	Cooled Dispensers (e.g. for vending, cold drinks)	0,5	0,7	0,9
		13,0	19,6	26,1

Method 6: Luca Test Centre (*high quality*)

6.1 Data sources and data collection

The LUCA test Centre is a testing facility set up in the port of Amsterdam where small exporters of used-EEE can test the devices, and export them to Africa.

6.2 Methods

The units of EEE that are tested are counted in the test center for 2018. The data was provided in “tested and approved material”, and “tested and disqualified material”. For this analysis, the data from “tested and approved material” was used.

The data from the LUCA test center was aggregated in four categories, and recorded in units. It was unclear whether the breakdown into those four categories was recorded like this, or already disaggregated by the data provider based on an estimate:

- Cooling & Freezing
- CRT TV / screens
- LCD TV / screens
- Small Household Appliances

The data was converted by using the average weights from the United Nations University (see table below). The breakdown into the UNU-KEYs has been made by an expert who has visited the site several times.

Category	UNU-KEY	Description	Average Weight (kg/unit)	Percentage within Category
Cooling & Freezing	0108	Fridges (incl. combi-fridges)	44	80%
	0109	Freezers	40	15%
	0111	Air Conditioners (household installed and portable)	27	5%
CRT TV / screens	0308	Cathode Ray Tube Monitors	19	40%
	0407	Cathode Ray Tube TVs	30	60%
LCD TV / screens	0309	Flat Display Panel Monitors (LCD, LED)	5,5	40%
	0408	Flat Display Panel TVs (LCD, LED, Plasma)	10	60%
Small Household Appliances	0202	Equipment for food preparation(e.g. toaster, grills, food processing, frying pans)	3,27	50%
	0204	Vacuum Cleaners (excl. professional)	5,8	50%

Table 7: Conversion of the Luca Test Centre data to UNU-KEYS

6.3 Results

A total of 55.182 units have been tested at LUCA, of which 53.736 were tested and approved.

Category	Units
Tested and approved	53.736
Tested and disqualified	1.446
Total tested	55.182

With the following breakdown:

Category	Breakdown	Amount in pieces
Cooling & Freezing	65%	34.928
CRT TV / screens	20%	10.747
LCD TV / screens	10%	5.374
Small Household Appliances	5%	2.687
	100%	53.736

This was converted into the following breakdown per UNU-KEY.

UNU-KEY	kg	kton	Average Weight	Percentage in CAT
0108	1.229.480	1,23	44	80%
0109	209.570	0,21	40	15%
0111	47.153	0,05	27	5%
0308	81.679	0,08	19	40%
0407	193.450	0,19	30	60%
0309	11.822	0,01	5,5	40%
0408	32.242	0,03	10	60%
0202	4.393	0,00	3,27	50%
0204	7.792	0,01	5,8	50%
Total	1.817.580	1,82		

Table 8: Conversion of the Luca Test Centre data to UNU-KEYS based on average weight

7. Method: Integration of data

7.1 Method

The outcomes are ranked by data quality, in which the LUCA (method 6) and data from the National WEEE Register (method 1) were ranked as “high quality”. This is data that is updatable for future years and based on real detailed registrations. The data provided from the desktop research (method 2), mostly the ‘server’ research from ICT Milieu has been ranked also as high quality. This is data based on real registrations, however, not easily updatable. Although, it is expected that there will be continuously servers exported for reuse, and it might also be covered more in the NWR after 2018.

The data based on a model on trade data, (method 3 and 4) were ranked as “medium quality”. This is also relatively easily updatable, but the model parameters have to be updated over time. The data based on the expert guess (method 5) were ranked as “low quality”. The outcomes were compared and the export for reuse was determined based on the best method per UNU-Key.

The following rationale was used:

- If it was suspected that two datasets had overlap, then the highest value was taken. If there was data available for a higher quality data source, then the part is allocated to the highest quality preferably. Thus, first high quality, then rest to medium quality, and the rest to highest low quality.
- If there is only one data point available, then that value has been used.

The matrix that was used for that is shown below:

UNU - KEY	Description	1: NWR	2: Report s	3: Trad e Data Pric e	4: Secon d hand vehicl e export s	5: exper t gues s	6: Luca	Remark
0001	Central Heating (household installed)							No data
0002	Photovoltaic Panels (incl. inverters)							No data
0101	Professional Heating & Ventilation (excl. cooling equipment)			Yes				
0102	Dishwashers			Yes				
0103	Kitchen equipment (e.g. large furnaces,							No data

	ovens, cooking equipment)							
0104	Washing Machines (incl. combined dryers)			Yes	Yes			Highest taken (method 4)
0105	Dryers (wash dryers, centrifuges)							No data
0106	Household Heating & Ventilation (e.g. hoods, ventilators, space heaters)				Yes			
0108	Fridges (incl. combi-fridges)					Yes	Yes, subset of Method 5	
0109	Freezers					Yes	Yes, subset of Method 5	
0111	Air Conditioners (household installed and portable)				Yes		Yes, subset of Method 4	
0112	Other Cooling equipment (e.g. dehumidifiers, heat pump dryers)							No data
0113	Professional Cooling equipment (e.g. large air conditioners, cooling displays)			Yes		Yes		Highest is taken
0114	Microwaves (incl. combined, excl. grills)				Yes	Yes		Highest is taken
0201	Other small household equipment (e.g. small ventilators, irons, clocks, adapters)							No data
0202	Equipment for food preparation (e.g. toaster, grills, food processing, frying pans)			Yes		Yes	Yes, subset of total	Highest is taken of three and 5.
0203	Small household equipment for							No data

	hot water preparation (e.g. coffee, tea, water cookers)							
0204	Vacuum Cleaners (excl. professional)			Yes		Yes	Yes, subset of total	Highest is taken of three and 5.
0205	Personal Care equipment(e.g. tooth brushes, hair dryers, razors)			Yes		Yes		Highest is taken of three and 5.
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	Yes, subset of the total	Yes			Yes		Highest is taken of method 2 and 5.
0302	Desktop PCs (excl. monitors, accessoires)	Yes, subset of the total	Yes			Yes		Highest is taken of method 2 and 5.
0303	Laptops (incl. tablets)	Yes, subset of the total	Yes			Yes		Highest is taken of method 2 and 5.
0304	Printers (e.g. scanners, multi functionals, faxes)			Yes	Yes			Highest taken (method 4)
0305	Telecommunication equipment (e.g. (cordless) phones, answering machines)			Yes				
0306	Mobile Phones (incl. smartphones, pagers)			Yes	Yes			Highest taken (method 4)
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	Yes, subset of the total	Yes					4.8 kt was from the desktop research, NWR records 1.7 kt.
0308	Cathode Ray Tube Monitors			Yes		Yes	Yes, subset of total	Highest is taken from 3 and 5.
0309	Flat Display Panel Monitors (LCD, LED)			Yes	Yes	Yes	Yes, subset of method 3 and 4	Highest is taken from 3, 4 and 5.

0401	Small Consumer Electronics (e.g. headphones, remote controls)							No data
0402	Portable Audio & Video (e.g. MP3, e-readers, car navigation)			Yes				
0403	Music Instruments, Radio, Hi-Fi (incl. audio sets)			Yes	Yes			Highest taken (method 4)
0404	Video (e.g. Video recorders, DVD, Blue Ray, set-top boxes) and projectors			Yes	Yes			Highest taken (method 4)
0405	Speakers				Yes			
0406	Cameras (e.g. camcorders, photo & digital still cameras)			Yes				
0407	Cathode Ray Tube TVs			Yes	Yes		Yes, subset of method 3 and 4	Highest taken (method 4)
0408	Flat Display Panel TVs (LCD, LED, Plasma)			Yes			Yes, subset of method 3	
0501	Small lighting equipment (excl. LED & incandescent)							No data
0502	Compact Fluorescent Lamps (incl. retrofit & non-retrofit)							No data
0503	Straight Tube Fluorescent Lamps							No data
0504	Special Lamps (e.g. professional mercury, high & low pressure sodium)							No data
0505	LED Lamps (incl. retrofit LED lamps)							No data
0506	Household Luminaires (incl. household incandescent)							No data

	fittings & household LED luminaires)							
0507	Professional Luminaires (offices, public space, industry)							No data
0601	Household Tools (e.g. drills, saws, high pressure cleaners, lawn mowers)			Yes				
0602	Professional Tools (e.g. for welding, soldering, milling)	Yes, subset of method 5				Yes		
0701	Toys (e.g. car racing sets, electric trains, music toys, biking computers, drones)							No data
0702	Game Consoles							No data
0703	Leisure equipment (e.g. sports equipment, electric bikes, juke boxes)			Yes				
0801	Household Medical equipment (e.g. thermometers, blood pressure meters)							No data
0802	Professional Medical equipment (e.g. hospital, dentist, diagnostics)					Yes		
0901	Household Monitoring & Control equipment (alarm, heat, smoke, excl. screens)			Yes				
0902	Professional Monitoring & Control equipment (e.g. laboratory, control panels)			Yes		Yes		Highest of method 3 and method 5
1001	Non- cooled Dispensers (e.g. for vending, hot	Yes						

	drinks, tickets, money)							
1002	Cooled Dispensers (e.g. for vending, cold drinks)	Yes, subset of method 5				Yes		

7.2 Results

For 2018, the export data reported in the National WEEE register are on a voluntary basis and only amount to 3 kton. Of this weight, 2.8 is small IT and 0.1 kton large equipment. As described in the methodology, five other methods were used to calculate the export of reused electrical and electronic equipment from the Netherlands. The outcome of the second method (desktop research) of FFACT, AmEcBoard and RTA/ICTM is export of 8 kton to 25 kton of used EEE. The outcome of the third and fourth method (based on trade statistics) is export of 17 kton of used EEE. The outcome of the fifth method (the analysis of reusability of UNU Key product groups) is export of 31 kton used EEE. The results from the Luca test centre is export of 2.4 kton of used EEE.

- The data point for exports for reuse (31 kt) was calculated by adding up the data sources of “high quality” with the ones from “medium quality”, and the mid end estimate of method 5 (expert guess). The detailed

The breakdown of the total (31 kt) per UNU-KEY is shown below in tonnage.

		Total (t)	High Qual.	Med. Qual.	Low Qual.
0001	Central Heating (household installed)	-		-	
0002	Photovoltaic Panels (incl. inverters)	-		-	
0101	Professional Heating & Ventilation (excl. cooling equipment)	1	0	1	
0102	Dishwashers	62	0	62	
0103	Kitchen equipment (e.g. large furnaces, ovens, cooking equipment)	-	0	-	
0104	Washing Machines (incl. combined dryers)	282	0	282	
0105	Dryers (wash dryers, centrifuges)	-	0	-	
0106	Household Heating & Ventilation (e.g. hoods, ventilators, space heaters)	19	0	19	
0108	Fridges (incl. combi-fridges)	2.150	1229		920
0109	Freezers	1.642	210		1.432
0111	Air Conditioners (household installed and portable)	282	47	235	
0112	Other Cooling equipment (e.g. dehumidifiers, heat pump dryers)				

0113	Professional Cooling equipment (e.g. large air conditioners, cooling displays)	1.631	0	247	1.385
0114	Microwaves (incl. combined, excl. grills)	1.087	0	188	899
0201	Other small household equipment (e.g. small ventilators, irons, clocks, adapters)	199		199	
0202	Equipment for food preparation (e.g. toaster, grills, food processing, frying pans)	493	4	14	474
0203	Small household equipment for hot water preparation (e.g. coffee, tea, water cookers)	953	0	953	
0204	Vacuum Cleaners (excl. professional)	255	8	145	102
0205	Personal Care equipment (e.g. tooth brushes, hair dryers, razors)	338	0	3	336
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	3.090	3090		
0302	Desktop PCs (excl. monitors, accessories)	2.298	34	2.265	
0303	Laptops (incl. tablets)	814	3	141	670
0304	Printers (e.g. scanners, multi functionals, faxes)	235	0	235	-
0305	Telecommunication equipment (e.g. (cordless) phones, answering machines)	1.589	0	1.589	
0306	Mobile Phones (incl. smartphones, pagers)	405	0	405	
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	4.814	4814		
0308	Cathode Ray Tube Monitors	1.358	82	8	1.269
0309	Flat Display Panel Monitors (LCD, LED)	2.596	235	2.362	
0401	Small Consumer Electronics (e.g. headphones, remote controls)	-			

0402	Portable Audio & Video (e.g. MP3, e-readers, car navigation)	12	0	12	
0403	Music Instruments, Radio, Hi-Fi (incl. audio sets)	432	0	432	
0404	Video (e.g. Video recorders, DVD, Blue Ray, set-top boxes) and projectors	251	0	251	
0405	Speakers	287	0	287	
0406	Cameras (e.g. camcorders, photo & digital still cameras)	108	0	108	
0407	Cathode Ray Tube TVs	658	193	465	
0408	Flat Display Panel TVs (LCD, LED, Plasma)	32	32		
0501	Small lighting equipment (excl. LED & incandescent)	-			
0502	Compact Fluorescent Lamps (incl. retrofit & non-retrofit)	-			
0503	Straight Tube Fluorescent Lamps	-			
0504	Special Lamps (e.g. professional mercury, high & low pressure sodium)	-			
0505	LED Lamps (incl. retrofit LED lamps)	-			
0506	Household Luminaires (incl. household incandescent fittings & household LED luminaires)	-			
0507	Professional Luminaires (offices, public space, industry)	-			
0601	Household Tools (e.g. drills, saws, high pressure cleaners, lawn mowers)	0	0	0	
0602	Professional Tools (e.g. for welding, soldering, milling)	87	1		86
0701	Toys (e.g. car racing sets, electric trains, music toys, biking computers, drones)	-	0		
0702	Game Consoles	-	0		
0703	Leisure equipment (e.g. sports equipment, electric bikes, juke boxes)	12	0	12	
0801	Household Medical equipment (e.g. thermometers, blood pressure meters)	-	0		

0802	Professional Medical equipment (e.g. hospital, dentist, diagnostics)	425	0	-	425
0901	Household Monitoring & Control equipment (alarm, heat, smoke, excl. screens)	204	0	204	
0902	Professional Monitoring & Control equipment (e.g. laboratory, control panels)	1.003	0	9	994
1001	Non- cooled Dispensers (e.g. for vending, hot drinks, tickets, money)	111	111	-	
1002	Cooled Dispensers (e.g. for vending, cold drinks)	709	0	-	709
		30.922	10.093	11.129	9.701

Category	High Quality	Medium Quality	Low Quality	Total
TEE	1.486	482	4.446	6.413
Screens, ...	545	2.975	1.939	5.459
Lamps	-	-	-	-
Large Eq. (ex. PV)	4.926	384	1.506	6.816
PV	-	-	-	-
Small Eq.	12	2.795	1.811	4.618
Small IT	3.124	4.493	-	7.617
Total	10.093	11.129	9.701	30.922

Table 2: Results from the different methods ranked by quality in the 6 WEEE Directive categories in ton

- The low end was calculated by adding up the data sources of “high quality” with the ones from “medium quality”, and the lower end estimate of method 5 (expert guess). This yielded in 27 kt.
- The high end was calculated by adding up the data sources of “high quality” with the ones from “medium quality”, and the higher end estimate of method 5 (expert guess). This yielded in 35 kt.

The bandwidths due to the low and high-end estimates were calculated for each of the six grouped categories. Then, the band width on the total was calculated by taking the root of the squares of all added-up bandwidths. This yielded 2,3 kton.

In conclusion, the exports for reuse in the Netherlands was $31 \pm 2,3$ kton in 2018.

7.3 Timelines to produce data

The timelines to produce the data differs per data source. This is shown in the table below. It appears that not all data sources will be available when the reporting of the NWR to the Ministry occurs (t+6 months).

Data source	Replicability for yearly monitoring	Timeliness	Remark
1. NWR	Good	t + 6 months	Can be part of regular monitoring tasks of NWR
2. Studies	Low		One-time studies
3. Price trade data	Good	t + 6 for CBS data. Then $\pm$ 1 month for calculations	
4. Vehicle exports data	Medium	t + 6 for CBS data. Then $\pm$ 1 week for calculations.	Conversion factors will soon be outdated.
5. Gap Exportability	Medium	t + 9	Can only be implemented if the NWR, and other WEEE Flows are monitored per UNU-KEY is yearly updated. This is possible, but not yet the case.
6. LUCA	Good	t + 6 months should be doable	

8. Recommendations for Monitoring Exports for Reuse

The recommendations how to monitor export for reuse in the future in the Netherlands are shown below.

1) The exports for reuse in year t (for instance t = 2019) should be subtracted from the WEEE collection target in the same year (2019). It is recommended to be included to the NWR reporting to the Ministry.

2) It is recommended to have a mandatory registration and reporting obligation for all national and international enterprises that export for reuse in the UNU-KEYs (ANNEX 1) into the NWR. This data will be ready with the current time lines for reporting from the NWR to the Ministry (t+6 months). The current time lines for reporting by producers to the schemes is (t+3 months).

3) It is recommended to add the small exporters of EEE from the test site LUCA into the NWR, to coordinate and facilitate their registration & reporting obligation centrally. This data will have to be provided by LUCA to the NWR, on behalf of the many small exporters, and preferably in the UNU-KEYs. It is expected that this can be realized within (t+3 months).

4) Since the registration of exports for reuse is relatively new, and the population of companies / persons engaged in this is not known, a cross check, or additional substantiated estimate, on LUCA and NWR data is needed for the coming years. This cross check can be done with method 3 (price trade data) and method 4 (exports in vehicles) using existing statistical data for the specific UNU-KEYs. Where needed, the under-coverage of the data can be calculated using method 3 (price trade data) and method 4 (exports in vehicles), and function as a substantiated estimate. This data will be ready around t+7 or t+8. Therefore, it is too late to be included of the NWR reporting to the Ministry (t+6 months). It is our suggestion to include the latest available data in the t+6 months reporting to the ministry. Thus, the actualized LUCA and NWR data, and the data of trade statistics of the year before in the reporting to the Ministry at t+6 months. The final data have to be actualized prior to submission of the data to DG Environment / Eurostat (t+18).

5) It is also recommended that WEEE Generated and WEEE Waste Bin have to be yearly monitored too by the NWR. Then an essential final quality check can be performing a gap assessment per UNU-KEY (or reporting category of WEEE Register) with method 5. It can be done by using this formula: $GAP = WEEE\ Generated - WEEE\ NWR - WEEE\ Waste\ Bin - Exports\ for\ Reuse$ (with the data from NWR, LUCA and Eurostat Trade Statistics). This can be done approximately at t+9.

6) The inclusion of exports for reuse for all recommended steps will add a new layer of complexity to the work of the NWR, and therefore delay the current reporting of the to the Ministry at t+6. Inclusion of Eurostat (recommendation 4) analysis can be done realized approximately t+8, and the final gap assessment (recommendation 5) at t+9.

7) When the recommendations are assigned to the NWR this will add new tasks to the NWR.

8) The parameters of the model for method 3 (price trade data) can be yearly adapted. The method 4 (exports in vehicles) should be adapted every 5 years, thus in 2021, to reflect the real behavior. This can be done by visual inspections, and generating new data of used-EEE in exported second hand cars to Western Africa. Maybe these types of statistics can be generated by already ongoing inspections from environmental inspection agencies.

ANNEX 1: UNU-KEYs with conversion to the EU (WEEE Directive) categories and NWR categories.

UNU	Full name	EU-6	EU-6PV	EU-10	NWR
0001	Central Heating (household installed)	4	4a	1	1c
0002	Photovoltaic Panels (incl. inverters)	4	4b	4	4d
0101	Professional Heating & Ventilation (excl. cooling equipment)	4	4a	1	1d
0102	Dishwashers	4	4a	1	1c
0103	Kitchen equipment (e.g. large furnaces, ovens, cooking equipment)	4	4a	1	1c
0104	Washing Machines (incl. combined dryers)	4	4a	1	1c
0105	Dryers (wash dryers, centrifuges)	4	4a	1	1c
0106	Household Heating & Ventilation (e.g. hoods, ventilators, space heaters)	4	4a	1	1c
0108	Fridges (incl. combi-fridges)	1	1	1	1a
0109	Freezers	1	1	1	1a
0111	Air Conditioners (household installed and portable)	1	1	1	1a
0112	Other Cooling equipment (e.g. dehumidifiers, heat pump dryers)	1	1	1	1a
0113	Professional Cooling equipment (e.g. large air conditioners, cooling displays)	1	1	1	1b
0114	Microwaves (incl. combined, excl. grills)	5	5	1	1c
0201	Other small household equipment (e.g. small ventilators, irons, clocks, adapters)	5	5	2	2
0202	Equipment for food preparation (e.g. toaster, grills, food processing, frying pans)	5	5	2	2
0203	Small household equipment for hot water preparation (e.g. coffee, tea, water cookers)	5	5	2	2
0204	Vacuum Cleaners (excl. professional)	5	5	2	2
0205	Personal Care equipment (e.g. tooth brushes, hair dryers, razors)	5	5	2	2
0301	Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	6	6	3	3c
0302	Desktop PCs (excl. monitors, accessoires)	6	6	3	3c
0303	Laptops (incl. tablets)	2	2	3	3b
0304	Printers (e.g. scanners, multi functionals, faxes)	6	6	3	3c
0305	Telecommunication equipment (e.g. (cordless) phones, answering machines)	6	6	3	3c
0306	Mobile Phones (incl. smartphones, pagers)	6	6	3	3c
0307	Professional IT equipment (e.g. servers, routers, data storage, copiers)	4	4a	3	3d
0308	Cathode Ray Tube Monitors	2	2	3	3a
0309	Flat Display Panel Monitors (LCD, LED)	2	2	3	3b

0401	Small Consumer Electronics (e.g. headphones, remote controls)	5	5	4	4c
0402	Portable Audio & Video (e.g. MP3, e-readers, car navigation)	5	5	4	4c
0403	Music Instruments, Radio, Hi-Fi (incl. audio sets)	5	5	4	4c
0404	Video (e.g. Video recorders, DVD, Blue Ray, set-top boxes) and projectors	5	5	4	4c
0405	Speakers	5	5	4	4c
0406	Cameras (e.g. camcorders, photo & digital still cameras)	5	5	4	4c
0407	Cathode Ray Tube TVs	2	2	4	4a
0408	Flat Display Panel TVs (LCD, LED, Plasma)	2	2	4	4b
0501	Small lighting equipment (excl. LED & incandescent)	3	3	5	5b
0502	Compact Fluorescent Lamps (incl. retrofit & non-retrofit)	3	3	5	5b
0503	Straight Tube Fluorescent Lamps	3	3	5	5b
0504	Special Lamps (e.g. professional mercury, high & low pressure sodium)	3	3	5	5c
0505	LED Lamps (incl. retrofit LED lamps)	3	3	5	5b
0506	Household Luminaires (incl. household incandescent fittings & household LED luminaires)	5	5	5	5a
0507	Professional Luminaires (offices, public space, industry)	5	5	5	5a
0601	Household Tools (e.g. drills, saws, high pressure cleaners, lawn mowers)	5	5	6	6
0602	Professional Tools (e.g. for welding, soldering, milling)	4	4a	6	6
0701	Toys (e.g. car racing sets, electric trains, music toys, biking computers, drones)	5	5	7	7
0702	Game Consoles	6	6	7	7
0703	Leisure equipment (e.g. sports equipment, electric bikes, juke boxes)	4	4a	7	7
0801	Household Medical equipment(e.g. thermometers, blood pressure meters)	5	5	8	8
0802	Professional Medical equipment (e.g. hospital, dentist, diagnostics)	4	4a	8	8
0901	Household Monitoring & Control equipment (alarm, heat, smoke, excl. screens)	5	5	9	9
0902	Professional Monitoring & Control equipment (e.g. laboratory, control panels)	4	4a	9	9
1001	Non- cooled Dispensers (e.g. for vending, hot drinks, tickets, money)	4	4a	10	10b
1002	Cooled Dispensers (e.g. for vending, cold drinks)	1	1	10	10a