The Dutch WEEE Flows 2020

What happened between 2010 and 2018?

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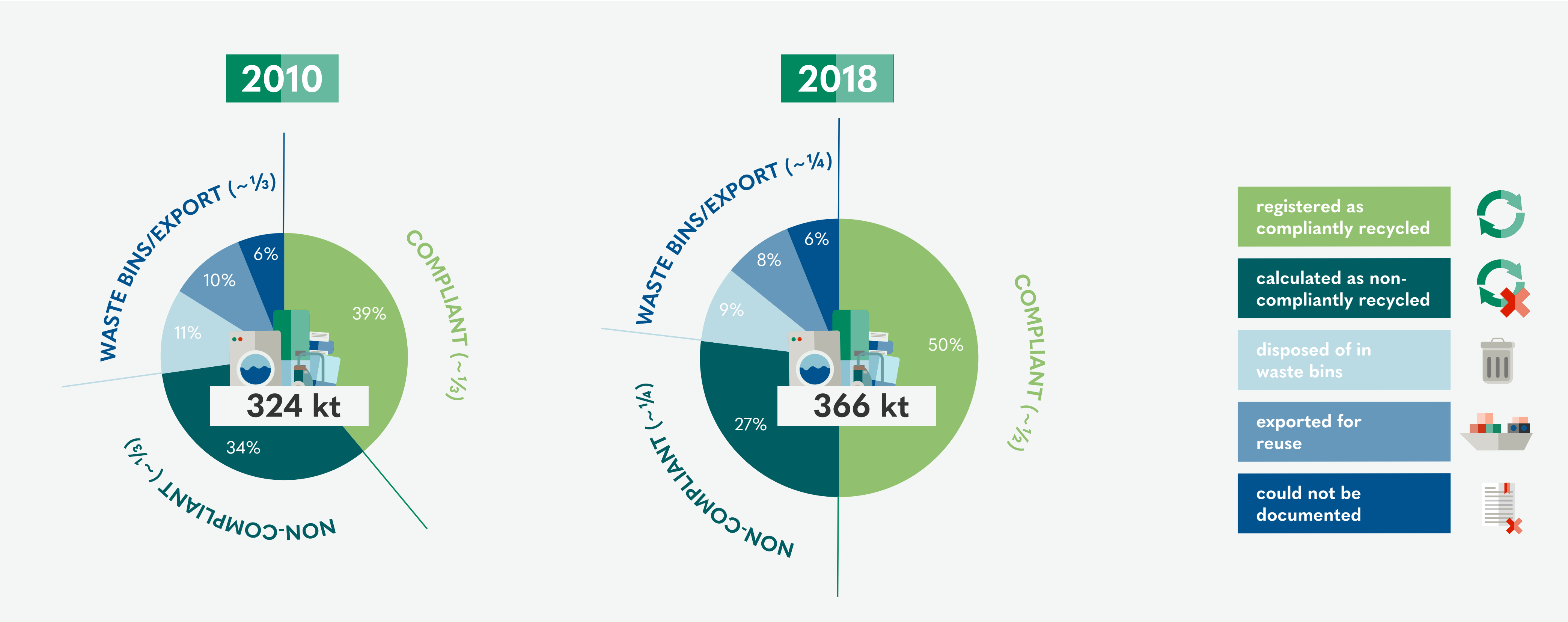
Executive summary

Waste of electrical and electronic equipment (WEEE) is regulated by the WEEE Directive (2012/19/EU) in the European Union.[1] Article 7 of the WEEE Directive states that the minimum collection rate to be achieved annually by a member state shall be 65% of the average weight of electrical and electronic equipment (EEE) placed on the market (POM) in the three preceding years or, alternatively, 85% of WEEE generated on the territory of a member state. In the Netherlands, WEEELABEX standard requirements are mandatory for WEEE treatment[2].

This report presents the EEE POM, WEEE Generated, the compliantly regulated WEEE Collection, and the WEEE Flows outside of the regulated WEEE management system in the Netherlands. The methodology of the study followed an internationally recognized measurement framework to integrate all available statistical data, field studies, household and business surveys, internal data from compliance schemes, and data from the National WEEE Register (NWR) for the Netherlands. The results for 2018 have been compared to the data of the methodologically equivalent Dutch WEEE Flows Study, which was conducted for reference year 2010[3].

The main findings are shown in Figure 1. In 2018, the WEEE Generated was 366 kt, half of which was registered as compliantly recycled in the NWR. Approximately one quarter is calculated to be non-compliantly recycled (27%), and roughly another quarter was disposed of in waste bins or exported for reuse, or could not be documented. In 2010, approximately one third (39%) was compliantly recycled, one third was non-compliantly recycled (34%), and another third (27%) was disposed of in waste bins, exported for reuse, or could not be documented. **In essence: the "one third, one third, one third" of 2010 improved to "half, one quarter, one quarter" in 2018.**

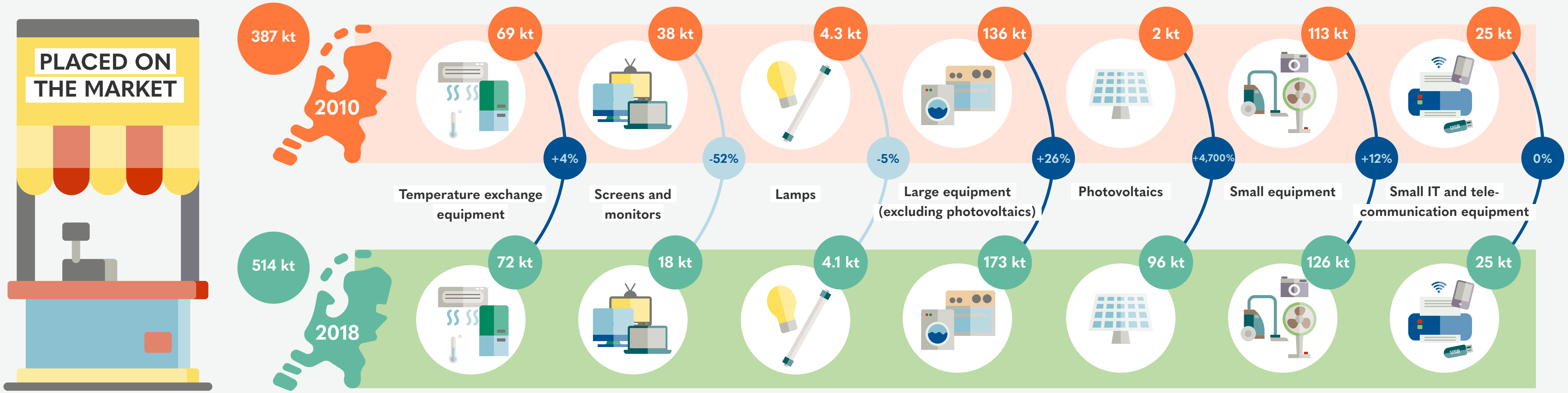
FIGURE 1. WEEE GENERATED AND WEEE FLOWS IN 2010 AND 2018



EEE POM

There are three complete datasets of the EEE POM in the Netherlands: the EEE POM of the NWR and the EEE POM from the apparent consumption method (see Table 1), as well as a consolidated EEE POM from this WEEE Flows Study (WFstudy), compiled after considering all available data and validating through the sales-stock-flow modelling. The results of this WEEE Flows Study (for 2018) are presented in Figure 2.

FIGURE 2. EEE POM IN 2010 AND 2018 (KT)



The EEE POM and WEEE Generated are calculated in this study by the 'apparent consumption method', data from the National WEEE Register, and lifespan method. The outcomes are cross-checked with stock levels for 20 main products, and checked for EU consistency with EU WEEE Directive Reporting. The EEE POM therefore differs from the weight for EEE POM of the National WEEE Register (NWR).

Methods for EEE POM

The implementation of the WEEE directive in the Netherlands stipulates that all producers who place EEE on the market should provide information to the NWR within one year. The sales-stock-flow modelling method is useful for validating the EEE POM data that is reported in the register. There is only a small difference of 19 kt (5%) between the EEE POM of this study and the EEE POM registered in the NWR. This difference is mostly noticeable in the small equipment category.

This variance can be explained by:

- the amounts of the small equipment category. In this category, free-riding, such as online trade of EEE POM, takes place;
- the inclusion of household luminaires in this study, which are absent in the NWR, and;
- inaccuracies in the methodologies employed.

The EEE POM calculated through the sales-stock-flow modelling method is comparable to the preliminary outcomes of the EU Common Methodology (excluding PV panels): 418 kt vs 419 kt.

Small differences are found for:

- screens;
- small IT;
- lamps;
- temperature exchange equipment.

The EU Common Methodology overestimated:

- small equipment (162 kt vs 126 kt).

The EU Common Methodology underestimated:

- large equipment (157 kt vs 173 kt).

WEEE Generated

The WEEE Generated is primarily the result of lifespans and the EEE POM from previous decades. Data from national registers are usually not available to cover the entire lifespans of certain EEE. Therefore, additional data sources, such as stock levels, market penetration, and data from official statistics, are essential to construct and validate the required time series of EEE POM. The WEEE Generated reflects the amount of WEEE on the Dutch market, prior to any collection activity, and was calculated by multiplying the EEE POM from 1980 to 2018 with the EEE lifespans. The lifespans included second-hand use and dormant time in stock. **The WEEE Generated was calculated as 366 kt in 2018. This is an increase of 41 kt (13%) compared to 2010.**

A sensitivity analysis on the WEEE Generated was done by running two scenarios in which all lifespans were 20% longer or 20% shorter. The variation on the total WEEE Generated due to lifespans was ±14 kt (4% total). Thus, the lifespan sensitivity of the WEEE Generated is relatively small. As most EEE POM show relatively stable data for the past two decades, a variation in lifespan has only a minor effect on the WEEE Generated. However, the situation is different if the EEE is new and does not replace an existing EEE, or when products phase out. The PV panel is a product that does not obey this rule and is heavy. Since PV panels are typically on the market only briefly and have long lifespans, they are not yet discarded.

FIGURE 3. WEEE GENERATED IN 2010 AND 2018 (KT)

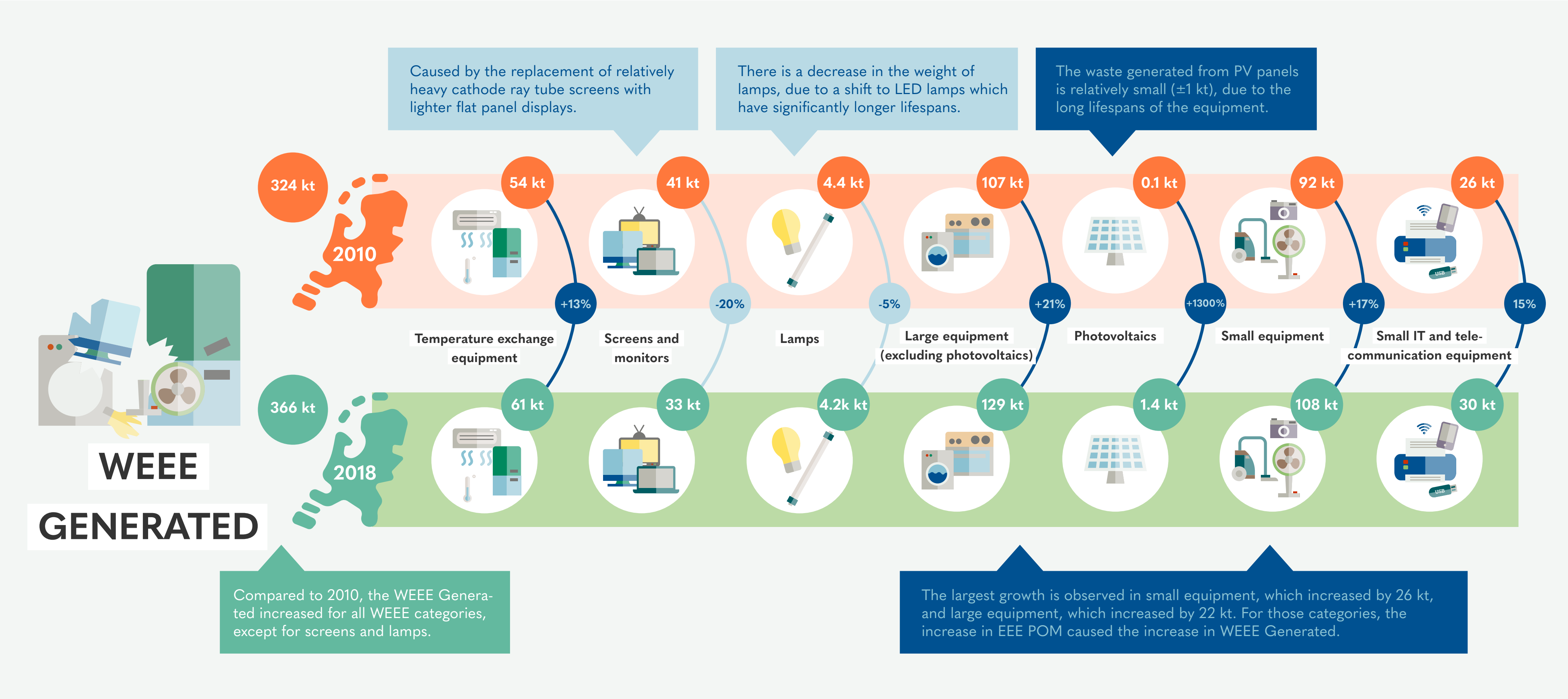
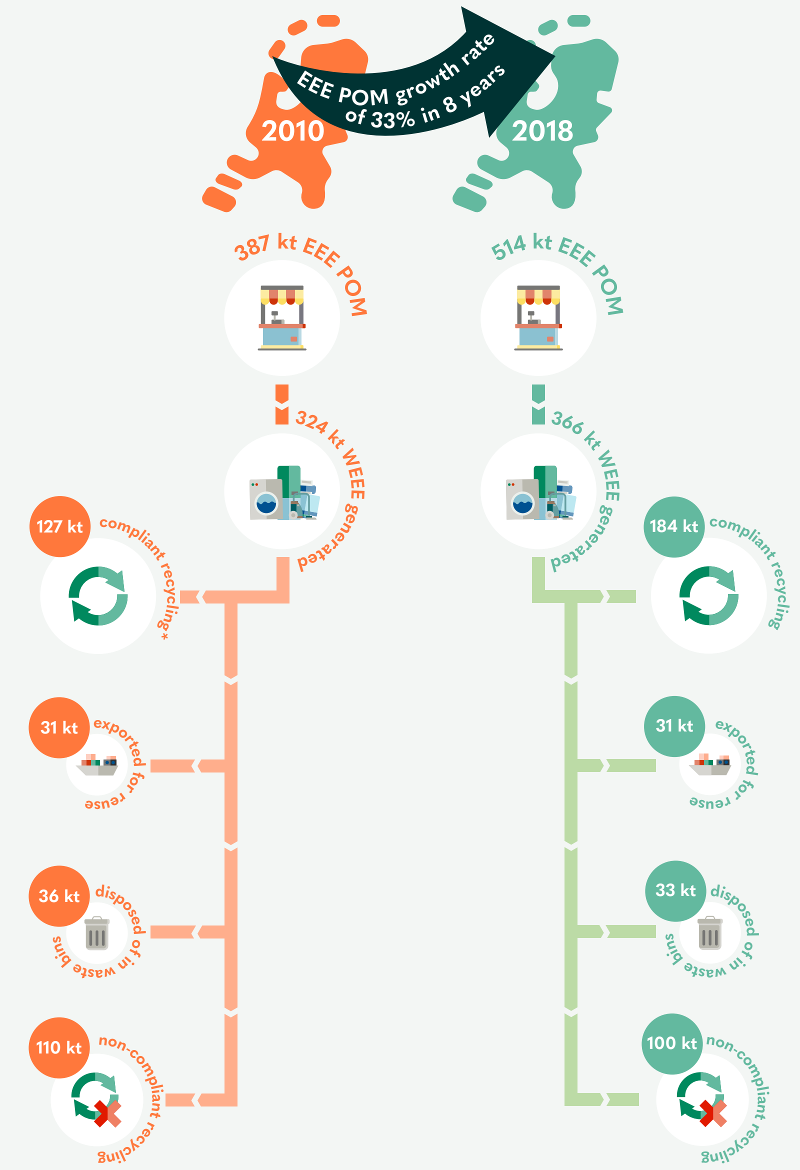


FIGURE 4. THE DUTCH WEEE FLOWS IN 2010 AND 2018



**In 2010, the compliant recycling was the WEEE collected and reported by the compliance schemes. The recyclers were not WEEELABEX certified yet.*

WEEE Flows

In the Netherlands, WEEELABEX certification has been mandatory by law since July 2015, and the present registration of WEEE collection data in the NWR is therefore based exclusively on WEEE treated in compliance with WEEELABEX.

In 2018, the WEEE collected and compliantly registered in the NWR was 184 kt. This is a 45% increase in weight compared to 2010.

- From the years 2010 - 2018, the share of the WEEE Generated that is formally and compliantly recycled increased from 39% to 50%.
- In 2018, the Netherlands reached the mandatory 45% collection target, based on the EEE POM of the three preceding years.
- On the other hand, with current data, the Netherlands will not reach the 65% EEE POM nor the 85% WEEE Generated collection targets (laid down in Article 7 of the WEEE Directive) that are in effect for 2019.

The WEEE Generated is 366 kt in the Netherlands and, according to the NWR, 50% (184 kt) of WEEE Generated treated is WEEELABEX compliant. Thus, additional information is required to understand the remaining 181 kt of WEEE Flows. These WEEE Flows are comprised of WEEE in waste bins, exported used EEE, and WEEE that is non-compliantly recycled.

Waste bins (33 kt).

- Sorting analysis of residual waste shows that WEEE in waste bins decreased by 10% between 2010 and 2018 to **33 kt**.
- The observed decrease in particular was caused by the decrease of small IT, which declined 60% from 12.9 kt to 5.2 kt.
- Despite the decrease, 9% of the WEEE Generated is still disposed in waste bins by households and businesses, and ongoing attention to consumer awareness and behaviour remains necessary.

Exports (31 kt).

- The NWR covers voluntary reports of export for reuse. However, at this moment, data is limited and only accounts for 3 kt in 2018. Based on the used identification and calculation methods in this study, the **export for reuse** is estimated to be **30.9 kt (±2.3 kt)**. This is in the same order of magnitude as the calculated EEE exports for reuse in 2010 (31 ±14 kt).

Non-Compliant Recycling (100 kt).

- Compared to 2010, the 2018 survey regarding non-compliant recycling used an equivalent inventory of metal collectors, traders, and recyclers in the Netherlands.
- However, the WEEE mixed with metal scrap, or managed by non-compliant metal scrap dealers, could not be directly quantified in 2018. Most metal scrap traders indicated that they either had become WEEELABEX compliant since 2010 and are now registered in the NWR, stopped entirely with WEEE recycling, or only transferred the collected WEEE to WEEELABEX compliant recyclers (according to the recent agreement between the "Nederlandse Verwijdering Metalelektro Producten" [NVMP], WEEE Nederland, and the Dutch Metal recycling Federation [MRF], referred to as MRF deal).
- In 2018, the non-compliantly recycled WEEE Flows could still be incorporated in mixed metal flows that were accepted by WEEELABEX-recyclers for treatment, but only as a minor percentage (approx. 0.5% WEEE in metal scrap). Secondly, the WEEE Flows could still be accepted in mixed 'pre-shredder' metal flows by non-compliant WEEELABEX-recyclers.
- In 2010, the WEEELABEX certification was not mandatory in the Netherlands. The metal scrap traders who cooperated during the previous 2012 study were able to provide accurate data. Therefore, this flow could be quantified as 110 kt.
- This flow also explained 84% of the gap between WEEE Generated and the sum of the WEEE Flows that could be documented (GAP = WEEE Generated – WEEE collected in NWR Register – WEEE in Waste Bins – Export for Reuse), i.e. 130 kt for 2010. For 2018, we assume that the same percentage of the gap, 118 kt in 2018, is non-compliantly recycled in 2018. This results in 84% * 118 kt = **~100 kt is still traded or mixed with other waste streams** or is still exported towards foreign recyclers, most likely in Belgium or Germany, and not registered in the NWR.
- The two most obvious supply routes to non-compliant recycling are curbside WEEE collection (collection with so-called 'white vans'), and retailers and installers who collect WEEE when a consumer purchases new equipment and transfer it for the highest price to a non-compliant metal trader.
- **The 2018 survey indicates that the WEEELABEX certification required by law has led to more transparency in the WEEE management chain, which is directly visible by the increase of the WEEE collection. However, recyclers without WEEELABEX certification have become more reluctant to provide accurate data, as it could incriminate them. As a result, the flows of WEEE mixed in metal scrap became less transparent in 2018 compared to 2010.**
- Along with the surveys, the metal companies that joined the MRF-deal, starting September 2019, were asked if they expected the WEEE registered to increase. They indicated an increase in annual collected weight of approximately 1 kt. Besides, the metal companies reported that in 2019, enforcement of WEEELABEX by inspections increased, which also stimulated additional registration.

TABLE 1. THE DUTCH WEEE FLOWS IN 2018 (KT)

2018	1. Temperature exchange equipment	2. Screens and monitors	3. Lamps	4a. Large equipment	4b. Photo-voltaics	5. Small equipment	6. Small IT and telecommunica-tion equipment	Total	Total (excl. photovoltaics)
EEE POM (NWR)	66	22	4.2	175	96	99	31	495	399
EEE POM (this study) (1)	72	18	4.1	173	96	126	25	514	418
EEE POM (art. 7 common methodology) (2)	58	18	4.4	157	105	152	29	523	419
WEEE Generated	±3 61	±2 33	±0.01 4.2	±8 129	±0.5 1.4	±5 108	±0.5 30	366	±15 365
Export for Reuse	±2 6.4	±0.7 5.5	-	±0.5 6.8	-	±0.7 4.6	±0 7.6	30.9	±2.3 30.9
WEEE in Waste Bins	0	1	0.4	1	0	25	5	33	33
WEEE Collected in NWR	34	16	1.8	69	0	44	19	184	184
Estimated Non-Compliant Recycling	17	10	0	42	0	31	0	100	100
Undocumented WEEE Flows	3.6	0.5	2	10.2	1.4	3.4	-1.6	18.1	17.1

(1) The EEE POM and WEEE Generated are calculated in this study by the 'apparent consumption method' data from the NWR and lifespan method. The outcomes are cross-checked with stock levels for 20 main products and checked for EU consistency with EU WEEE Directive Reporting. The EEE POM therefore differs from the weight for EEE POM of the NWR.

(2) This is the preliminary version of the dataset for the common methodology. It is expected to be refined later in 2020.

TABLE 2. THE DUTCH WEEE FLOWS IN 2010 (KT)

2010	1. Temperature exchange equipment	2. Screens and monitors	3. Lamps	4a. Large equipment	4b. Photo-voltaics	5. Small equipment	6. Small IT and telecommunica-tion equipment	Total	Total (excl. photovoltaics)
EEE POM (this study) [3]	69	38	4.3	136	2	113	25	387	385
WEEE Generated	54 ±4	41 ±3	4.4 ±0.2	107 ±10	0.1 ±0.04	92 ±6	26 ±1	324 ±24	324 ±24
Export for Reuse	6 ±3	7 ±3	-	6 ±3	-	5 ±3	7 ±2	31 ±14	31 ±14
WEEE in Waste Bins	-	1	0.4	1	-	21	13	36	36
WEEE Collected in the Netherlands	25	33	1.7	36	-	24	7	127	127
Calculated Non-Compliant Recycling	8	7	0	68	-	16	11	110	110
Undocumented WEEE Flows [4]	15	-7	2.2	3	0	26	-12	21	21

(3) The EEE POM and WEEE Generated are calculated in this study by the 'apparent consumption method' data from the NWR and lifespan method. The outcomes are cross-checked with stock levels for 20 main products and checked for EU consistency with EU WEEE Directive Reporting. The EEE POM therefore differs from the weight for EEE POM of the previous report.

(4) There are negative undocumented WEEEE Flows. They are probably a result of the uncertainties of the WEEE Flows.

Recommendations

1. The WEEE Generated target is a more balanced reference for the collection target laid down in Article 7 of the WEEE Directive, as it better reflects the available WEEE in the Dutch market.

The impact of EEE POM that does not directly lead to waste generated is significant. This is most prominently associated with PV panels, which show EEE POM of 96 kt in 2018, e-bikes, open scope products, or other new (innovative) products with a very long lifespan, such as luminaires with LED lamps. Therefore, a moving target of 65% EEE POM on the three previous years is volatile and not an accurate reference because the PV panels, e-bikes, open scope products, and LED lamps will simply not become waste in the next 10-20 years. In other words, an EEE POM target reflects neither the real WEEE that is generated nor the WEEE that is available for collection in the country. An EEE POM-based target is therefore very difficult to apply and control by Member States. A WEEE Generated-based target compensates for the unavailable part of WEEE, including lifespans, and uses the WEEE amount that is on the market prior to any collection activity. The WEEE Generated methodology also offers the ability to validate EEE POM and lifespans with the sales-stock-flow modeling, which increases the accuracy of the WEEE Generated.

2. Link collection target to WEEE Available For Collection

Although the WEEE Generated of 366 kt better reflects the WEEE that is available on the market, the outcomes of this study show that not all WEEE Generated can be easily collected for the following reasons:

- Despite consumer awareness campaigns, bad consumer behaviour still exists, as 33 kt of WEEE are still disposed of in waste bins, and appliances are disposed of at curbside. This behaviour of the consumer will never be fully eradicated and needs to be considered when setting the WEEE collection target.
- Around 31 kt of the used EEE is exported outside the Netherlands and therefore will not become waste in the country. These exports for reuse are considered as part of the circular economy, but they make it very difficult, if not impossible, to reach the collection targets in the Netherlands. There is a trade-off between valorization of used EEE in the context of a circular economy and collecting as much as possible WEEE for recycling.

It could be recommended that the WEEE collection target is linked to the WEEE Available For Collection (WEEE AFC), which is based on WEEE Generated and subtracted for WEEE that cannot be collected by compliance schemes because of exports or improper disposal by consumers. Although the WEEE AFC is currently not defined, two suggestions of how to calculate it are presented below:

1) WEEE Generated minus a) Exports for Reuse and b) WEEE in waste bins. This implies that a policy and an additional target must be in place to incentivize and minimize the improper WEEE in waste bins.
2) WEEE Generated minus only Exports for Reuse. This calculation method already implies that WEEE in waste bins should be minimized.

3. Improve reporting and the WEEE system

This study shows that monitoring of the WEEE management is already very complex, as it changes rapidly over time due to product innovations. Additionally, the WEEE system will be increasingly influenced by the energy transition policies of the Dutch government stimulating PV, heat exchangers, LED lighting, etc. It is also uncertain if and how circular economy policies will impact this waste stream. Therefore, accurate and up-to-date information is essential.

Though there is currently accurate information on the EEE POM and the total quantity that is WEEELABEX compliantly recycled, there are several data gaps:

- There is no public information on the remaining 50% of the WEEE market.
- The reporting to the NWR uses 14 product groups, but there is still limited information on the flows of individual products. Information about individual products could help to determine the value and environmental impact of the materials that flow to non-compliant recycling.

Improving currently unreported WEEE Flows and getting more detailed data facilitates, data-driven and product-specific interventions, and monitoring is imperative. Information on the actors in the chain, and on the specific products they collect, can also improve measures to increase the transparent recovery of valuable raw materials, which is important for a circular economy.

Therefore, it is recommended that all EEE, WEEE Generated, and WEEE Flows be monitored periodically, including the monitoring of raw materials and recyclables recovered from WEEE. This could be done with the following actions:

- Monitoring the EEE POM and WEEE Collected in the NWR in the UNU-KEYS.
- Annual monitoring of WEEE in waste bins specified in the UNU-KEYS in the NWR.

- Annual monitoring of exports for reuse, for example by a mandatory registration obligation of export for reuse in the NWR and by monitoring the LUCA test site data.
- Annual monitoring of the WEEE collected at retailers, supermarkets, and municipal collection points, and a mandatory reporting of the WEEE they supplied to WEEELABEX recyclers.
- Annual monitoring of WEEE that is non-compliantly recycled. There should be more reporting and transparency on the management of valuable WEEE Flows by non-compliant recyclers. This could include:
  - » a monitoring structure to estimate non-compliant recycling flows by information from the enforcement authorities from on-site inspections combined with specific market information.
- Calculating the WEEE Generated annually with new data from the NWR, and recalibrating every five years with new lifespans and a quality check of the EEE POM.
- Updating lifespans every 5 years if there are new market developments.
  - » Use stocks cross-checking of EEE appliances in businesses and households by stock calculated with the EEE POM-Stock-WEEE Generated calculation method.
- An annual quality check should be done by performing a gap assessment per UNU-KEY using this formula: GAP = WEEE NWR + WEEE in Waste Bins + Export for Reuse + WEEE collected by non-compliant recyclers.
- Monitoring material compositions of products that enter the market as well as the secondary raw materials that are reclaimed and lost during WEEE management.

4. To improve the WEEE market towards compliant recycling and circular economy

In 2010, 39% of the WEEE was collected by the compliance schemes, 34% of the Dutch WEEE was managed by the metal scrap sector, and the remaining 27% was discarded in waste bins, exported for reuse, or could not be determined. In 2018, the landscape changed due to legislation. Registration increased, but is still limited to 50%. Further increase in registration requires a more fundamental change of the current structure to enforce compliant management of WEEE and finance the transparent collection of WEEE in the Netherlands. Some actions are shown in Figure 5.

FIGURE 5. RECOMMENDATIONS

50% of the WEEE is compliantly recycled

27% is managed non-compliantly, by the metal scrap sector. Despite legislative actions to make the WEEE collection compliant, mixing and accepting WEEE by non-certified metal scrap traders still happens

9% is disposed of in waste bins

8% is exported for reuse

6% is unknown

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LIST OF ABBREVIATIONS AND DEFINITIONS

CRT	Cathode-ray tube.
EEE	Electrical and electronic equipment.
kt	Kilotonnes (thousand metric tonnes or 1,000,000 kg).
Lifetime	The period from EEE POM to WEEE: this includes the lifespan of the equipment, the second-hand use and the stock time (the time that non-functioning or unused equipment are dormant at households or businesses).
Mt	Megatonnes (million metric tonnes).
NVMP	Nederlandse Verwijdering Metalelektro Producten.
NWR	National WEEE Register.
POM	Placed on the Market.
PV	Photo voltaic.

LIST OF ABBREVIATIONS AND DEFINITIONS

UNU-KEYS	The UNU-KEYs are a product categorization of 54 electronic and electrical products that form a classification system for WEEE statistics.
Wecycle	Wecycle is a producer responsibility organisation that organises the collection and recycling of WEEE in the Netherlands.
WEEE	Waste of electrical and electronic equipment.
WEEE Generated	The amount of discarded electrical and electronic products (e-waste [see WEEELABEX below]) due to consumption within national territory in a given reporting year, prior to any collection, reuse, treatment, or export.
WEEELABEX	WEEE Laboratory of Excellence: set of harmonized standards regarding collection, transport, and recycling of e-waste.
Weibull	The Weibull distribution is one of the most widely used lifetime distributions. It is a versatile distribution that can take on the characteristics of other types of distributions, based on the value of the shape parameter.
WF	WEEE Flows.

Chapter 1. Introduction

Electronic waste, or e-waste, refers to all electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of reuse[(4)]. Waste of electrical and electronic equipment (WEEE) is one the fastest growing waste streams globally. It is estimated by the Global E-waste Monitor that the whole European region generated 12.4 million metric tonnes (Mt) of WEEE in 2016 and that this amount continues to grow[(5)]. WEEE is a complex mixture of valuable materials, but also includes hazardous substances. Therefore, if not properly managed, it can cause major environmental and health problems. To improve the environmental management of WEEE and to contribute to a circular economy and enhance resource efficiency, collecting and monitoring WEEE is essential[(6)].

The first ever comprehensive national WEEE study that described all flows was commissioned by Wecycle, NVMP, and ICT milieu and was executed by the United Nations University, FFACT, Statistics Netherlands, and Witteveen+Bos. In that study, the entire Dutch WEEE Flows have been quantified for 2010[(3)]. Retrospectively, the developed methodology proved to be a solid basis of other national WEEE studies, including the EU common methodology on the WEEE Generated calculations[(7)] and the global standard for WEEE Statistics[(8)]. Combined with the large impact of the methodology, the statistical findings of that study also impacted national and international policymaking to improve WEEE management.

The objective of this study is to quantify the 2018 Dutch WEEE Flows in a methodological manner comparable to 2010 and, where possible, for the years in between. This is especially important as the legislative context has changed significantly since 2010 (see Box 1 for more information). Since July 1, 2015, treatment operators have been forced to process WEEE according to WEEELABEX[(2)] (now CENELEC) standards and to report to the National WEEE Register (NWR). Article 7 of the WEEE Directive has been enforced since 2019 and states that the minimum collection rate to be achieved annually is 65% of the average weight of EEE placed on the market (POM) in the three preceding years by the Netherlands or, alternatively, 85% of WEEE Generated in the territory of the Netherlands. Have the changes in legislation impacted the WEEE Flows and, if so, how?

The WEEE Directive

The Directive 2002/96/EC was repealed on February 15, 2014 and has since been replaced by Directive 2012/19/EU on waste electrical and electronic equipment (WEEE)[1]. The directive regulates the collection, recycling, and recovery of e-waste.

Regulation nr. IENM/BSK-2014/14758[9]

The implementation of the WEEE Directive in the Netherlands is described in regulation nr. IENM/BSK-2014/14758: "afgedankte elektrische en elektronische apparatuur." Some topics that affected the WEEE market and flows include: the new collection targets in the Netherlands, the processing according to the WEEELABEX standards, and the reporting to the NWR.

WEEE Directive–collection targets (Article 10)

To ensure WEEE is collected, the European Commission introduced an ambitious WEEE collection target.

In 2016, the WEEE collection target was at least 45% of the average weight of EEE POM in the three preceding years.

As of 2019, the minimum collection target to be achieved is:

- At least 65% of the average weight of EEE POM in the three preceding years in the Member State Concerned or;
- At least 85% of WEEE Generated[1].

Appropriate treatment (Article 11)–WEEELABEX

- As of July 1, 2015, discarded EEE should be processed according to the WEEELABEX standards[10].

WEEELABEX stands for WEEE LABel of EXcellence. The WEEELABEX standards were introduced in April 2011 and were followed by the creation of an official WEEELABEX organisation to help implement these standards across Europe. The objective of the organisation is to ensure high-quality treatment of WEEE according to the standard.

On the European level, there is a follow-up standard of WEEELABEX, called CENELEC "Comité Européen de Normalisation Electrotechnique", which is responsible for European standardization in the area of electronics.

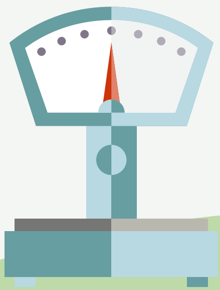
Registration (Article 16, 18-20) NWR

In Article 16, the regulation stipulates that all producers that put EEE on the market should provide information within one year about this EEE with regards to preparations for reuse and treatment.

The NWR will be responsible for the management of the registration. Every year, before July 1, the NWR will report:

- The total quantity of EEE POM.
- The total quantity of processed/treated WEEE.
- The results with regards to achieving the collection targets.

All producers and treatment operators must report the EEE POM and the WEEE treated before May 1 on an annual basis. The reporting is done in categories as defined by the European Commission.



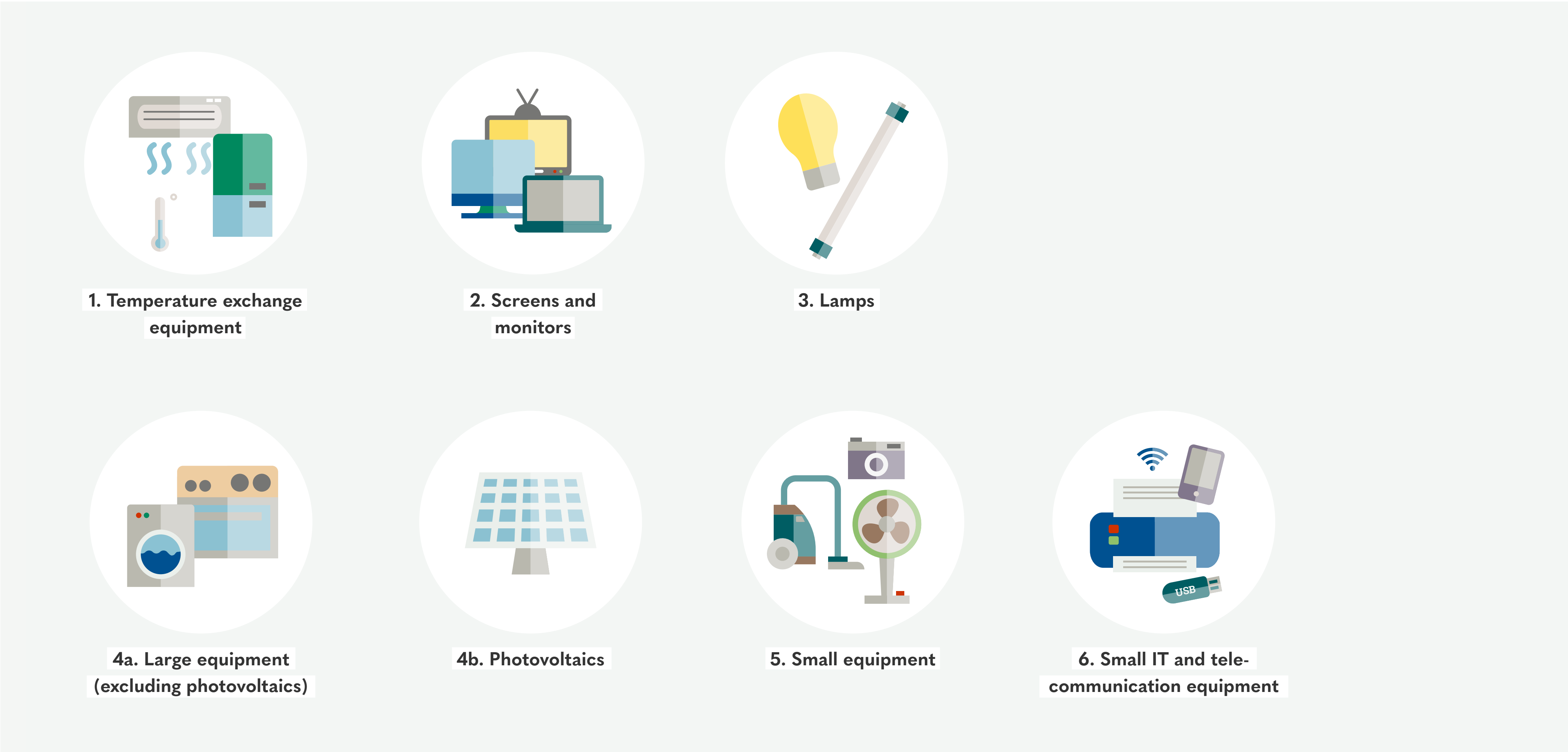
Chapter 2. Methodology

2.1 Classifications

There are many types of EEE products on the market and therefore they need to be grouped into sensible and practically useful categories. Many classifications are used to describe WEEE. This study will use the UNU-KEYS, the categories (6 and 10) in the WEEE Directive, and the classification used by the NWR. The descriptions of the classifications, and the corresponding tables, are listed in ANNEX 1.

All data in this study is presented in six categories of the WEEE Directive (see Figure 6). Large equipment is split into two categories, both excluding and including Photovoltaics.

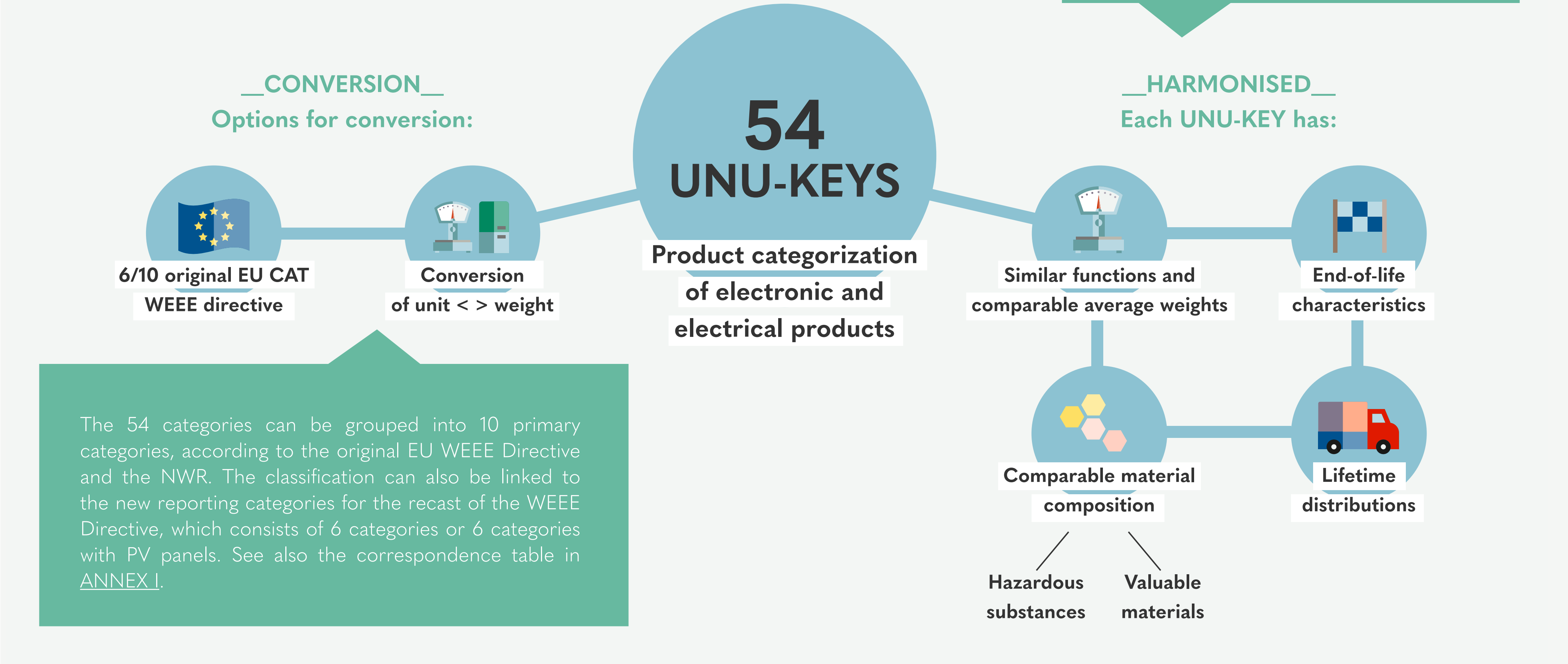
FIGURE 6. THE SIX CATEGORIES OF THE WEEE DIRECTIVE



The UNU-KEYS are a product categorization comprised of 54 products. The UNU-KEYS are in use by the European Union to perform EEE POM and WEEE Generated calculations, as laid down in the common methodology of Article 7 of the EU WEEE Directive. The UNU-KEYS are constructed in such a way that product groups share comparable average weights, material compositions, end-of-life characteristics, and lifetime distributions. The UNU-KEYS classification is ideal for serving as a link between the EU categories and the existing classifications. All data has been gathered, and calculations have been performed at the level of the UNU-KEYS.

The UNU-KEYS are constructed such that product groups share similar functions, comparable average weights, comparable material composition (in terms of hazardous substances and valuable materials), end-of-life characteristics, and lifetime distributions. Large or environmentally relevant WEEE is assigned separately (uniform Environmental Relevancy). This makes the system very useful for compiling WEEE statistics.

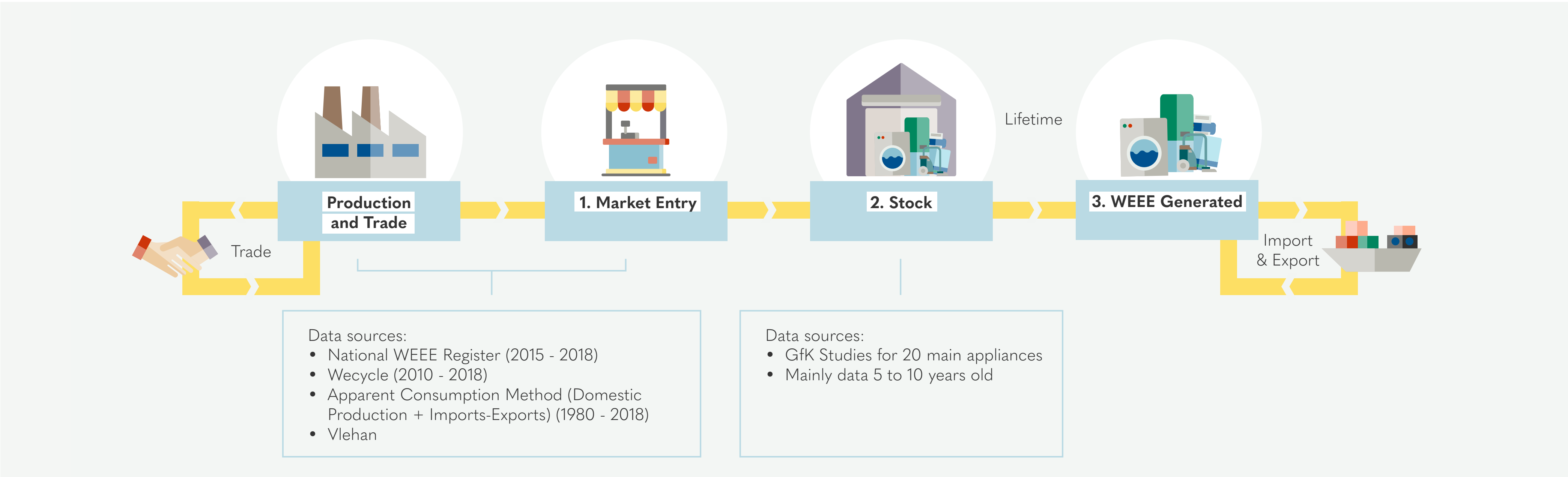
FIGURE 7. THE UNU-KEYS



Measurement Framework

The internationally agreed-upon measurement framework for WEEE statistics is shown in Figure 8. It is based on flows and stocks of EEE and WEEE. The model is constructed in such a way that the stocks and flows relate to one another. The proposed measurement framework integrates those parameters, such that directly comparable indicators could be constructed in order to allow further cross-country comparison.

FIGURE 8. MEASUREMENT FRAMEWORK OF WEEE STATISTICS (WITH DATA SOURCES)

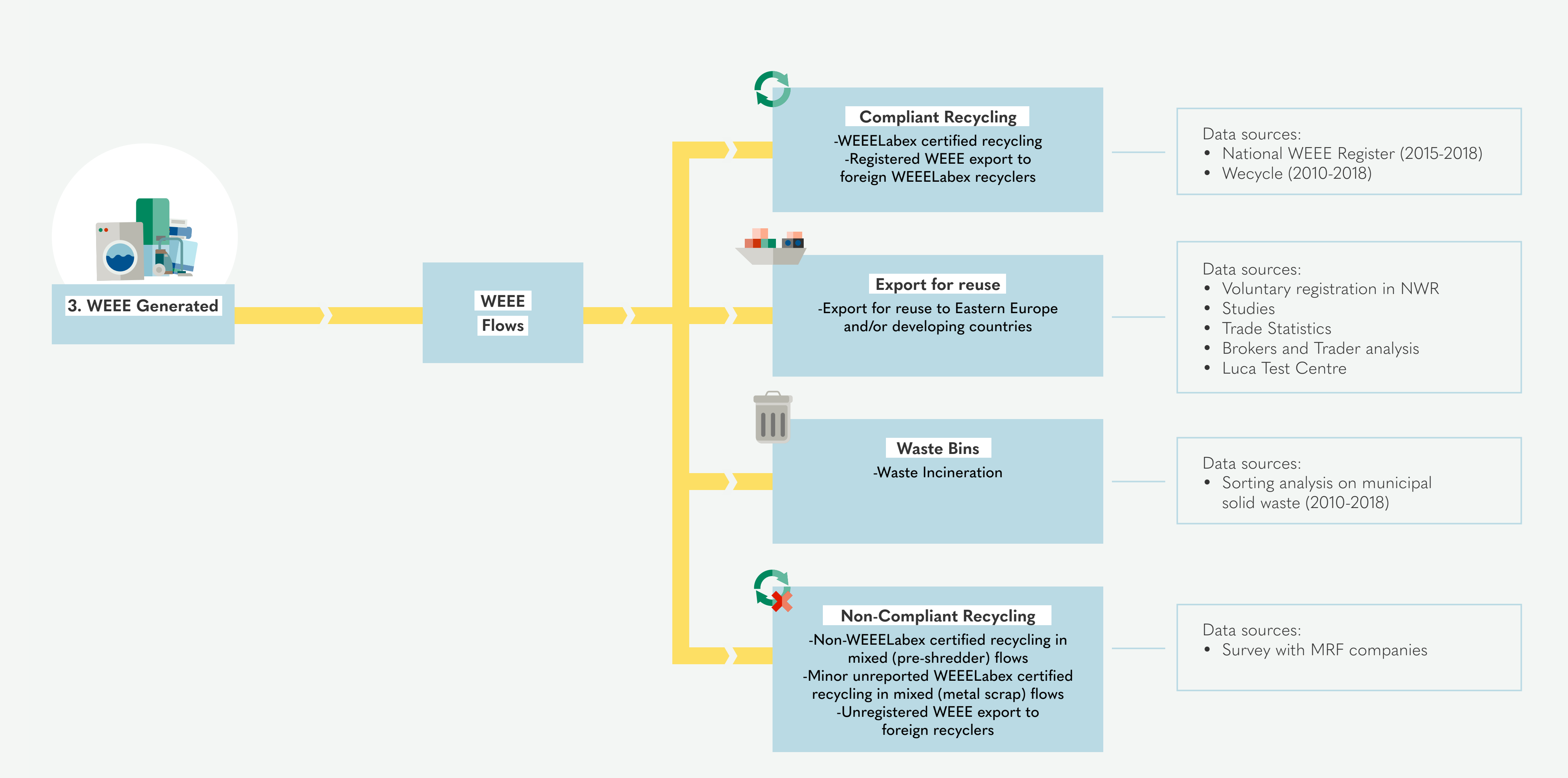


Phase 1: The measurement framework starts with tracking the Production and Trade of EEE to calculate the EEE Put on the Market. It is essential that the EEE POM data is included for a relatively lengthy period of time, preferably beginning in 1980 for each UNU-KEY.

Phase 2: After the equipment has been placed on the market, it stays in households or businesses for some time until it is discarded, and it becomes waste, so-called WEEE. This period from EEE POM to WEEE is called lifetime, which includes second-hand use and the dormant time. The equipment in households, businesses, and the public sector is referred to as the stock. When a second-hand functioning product is exported, the lifetime in that country also comes to an end.

Phase 3: After a certain lifetime, which varies from product to product, the good is disposed of, and it becomes waste. This is referred to as WEEE Generated. It is the annual supply of domestically generated WEEE prior to collection, without imports of externally generated EEE waste.

FIGURE 8. MEASUREMENT FRAMEWORK OF WEEE STATISTICS (WITH DATA SOURCES)



Phase 4: WEEE Management > The WEEE Generated is usually recycled by WEEELabex certified recyclers, exported for reuse, incinerated, or recycled by non-WEEELabex recyclers.

WEEE Flows

The measurement framework follows the life cycle from the production and trade of EEE to final disposal of WEEE. It starts with tracking the EEE POM. After the equipment has been placed on the market, it stays in households or businesses for some time until it is discarded, and it becomes waste, or WEEE. This period from EEE POM to WEEE is called lifetime, which includes second-hand use and the time the equipment is dormant. The "stock" is the equipment in households, businesses and the public sector. When a second-hand, functioning product is exported, the lifetime in that country also comes to an end. After a certain lifetime, which varies from product to product, the good is disposed of, and it becomes waste. This is referred to as WEEE Generated, which is the annual supply of domestically generated WEEE prior to collection, without imports of externally generated EEE waste.

1. In the Netherlands, the "formal collection" activities are performed under the requirement of national WEEE legislation, in which WEEE is collected by designated organisations. This mostly happens in the Netherlands via retailers, municipal collection points, and/or pick-up services by the municipality. The final destination for the WEEE is a WEEELABEX compliant treatment facility, which recovers the valuable materials in an environmentally sound way.

2. WEEE or second-hand products are sometimes shipped to other countries. Those import or export flows also need to be documented. The export of second-hand products is assessed in this study and is referred to as export for reuse.

3. WEEE can also end up in normal Waste Bins. In this scenario, consumers directly dispose of WEEE in normal Waste Bins with other types of household waste. As a consequence, the disposed WEEE is then treated with regular household mixed-waste. This waste is most likely incinerated without material recycling in the Netherlands.

4. The "other recycling" activities are collection, dismantling, and recycling that takes place outside the official (WEEELABEX certified) take-back system. The recycling of WEEE that is non-compliant with WEEELABEX has been considered illegal in the Netherlands since 2015.

Overview of data sources and mathematical equations

EEE POM

The model starts by tracing the EEE POM of products in the 54 UNU-KEYS. For EEE POM, two data sources of the EEE POM have been assessed. The first method was EEE POM using the *apparent consumption method* (see below) and has been calculated from 1980 to 2018 for 54 UNU-KEYS. This is also known as the Common Methodology in Article 7 of the WEEE Directive. The apparent consumption method has been used with updated parameters.

$$POM (t) = Domestic\ production (t) + Imports (t) - Exports (t)$$

Apparent Consumption Method

The outcomes of the apparent consumption method have been cross-checked with both the EEE POM data from Wecycle at UNU-KEY level and cross-checked with the aggregated data of EEE POM in the NWR. If large deviations were found, the data from the apparent consumption method were adjusted to match the EEE POM from the NWR, or from Wecycle. The data from Wecycle was converted to the UNU-KEYS, and the apparent consumption method also yielded data in the UNU-KEYS. The NWR uses a different classification, which could be related to the UNU-KEYS using the correspondence table in ANNEX 1.

Lifespans

The lifetime, L(p) (t, n), is the lifetime profile of an EEE sold in year *t*, which reflects its probable obsolescence rate in evaluation year *n*. The discarded-based lifetime profile for a product could be modelled using several probability functions. *The Weibull distribution function* is considered to be the most suitable for describing discard behaviour for EEE and has been applied in the European Union and in scientific literature[15,16].

Due to social and technical developments, the lifetime of a product could be time-dependent. For instance, the Cathode Ray Tube Monitor rapidly became outdated, due to the technological developments of flat screen monitors. In that case, lifetime distributions should ideally be modelled for each historical sales year. The Weibull function is defined by a time-varying shape parameter α (*t*) and β (*t*) a scale parameter as described below.

$$L^{(p)} (t, n) = \frac{\alpha (t)}{\beta (t)^{\alpha(t)}} (n-t)^{\alpha(t)-1} e^{-[(n-t)/\beta(t)]\alpha(t)}$$

Weibull Distribution Function

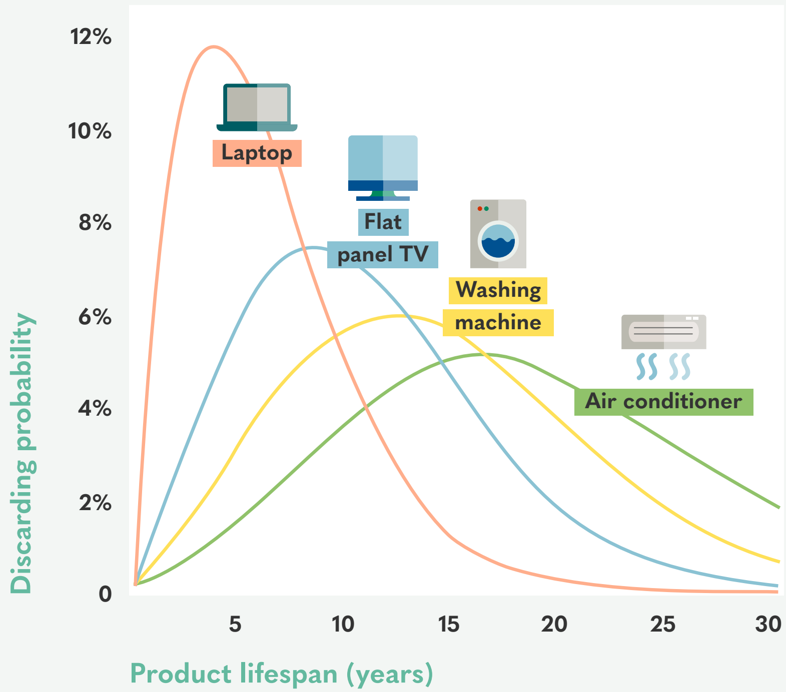
For other, more stable products, time-independent lifetimes sufficiently describe actual behaviour. In those cases, the variations of the shape and scale parameter over time are minor, and the variations can be neglected. Then, the distribution of product lifetime can be simplified as follows:

$$L^{(p)}(t, n) = \frac{\alpha}{\beta^{\alpha}}(n-t)^{\alpha-1}e^{-[(n-t)/\beta]\alpha}$$

Distribution of Product Lifetime

UNU has developed product-specific lifespans for all 54 UNU-KEYS for the Netherlands in the previous WEEE Future Flows Study from 2012. Those lifespans were validated by comparing the stocks of GfK-data supplied to UNU in the project and were adjusted where needed.

FIGURE 9. PRODUCT LIFESPANS (IN YEARS)



Stock

The stock levels of households and businesses per appliance was available from GfK studies. Several studies were carried out in the past decade, and all were assessed for this study. Where possible, the total stock of businesses and households was assessed by extrapolating the years and then adding up the figures. For information on this, see also section 2.8: Sales-Stock-Flow Modelling.

2.3 WEEE Generated

WEEE Generated is a function of the lifespans and the EEE POM in the previous years. Where WEEE Generated (n) is the quantity of WEEE Generated in evolution year n, POM (t) is the product sales (POM) in any historical years t prior to year n; t_0 is the initial year that a product was sold; L(p) and (t, n) is the discard-based lifetime profile for the batch of products sold in historical year t. A sensitivity analysis has been carried out to calculate the bandwidth on WEEE Generated that results from the lifespans. In the sensitivity analysis, the impact of two extreme scenarios, where the lifespan for all UNU-KEYS was 1) 20% longer, and 2) 20% shorter, was calculated.

$$\text{WEEE Generated}(n) = \sum_{t=t_0}^{n} POM(t) * L^{(p)}(t, n)$$

WEEE Generated

2.4 WEEE Collected

For 2010 to 2014, Wecycle provided WEEE Collection data per UNU-Keys. The data in UNU-Keys can be converted to the six categories of the WEEE Directive (see section 2.1). For 2014 to 2018, the NWR provided WEEE collection data in 22 categories. These were linked to the six categories by using the UNU-KEYS and by using more detailed data from Wecycle and the WEEE Generated data. The correspondence table is shown in ANNEX 1.

2.5 Complementary recycling flows / WEEE informally collected

Data on complementary recycling flows were obtained through an update of the extended market survey of 2012 (2010 data).

For the 2018 data, FFact prepared a questionnaire (in Dutch) to survey the weight of received and treated WEEE, specified in the six categories. Companies were asked to describe the source, type of treatment, and destination for all (partly dismantled) appliances, parts, and materials that were processed. The survey was sent to 26 selected recyclers on the national and regional levels, mostly members of the MRF and/or EERA. The questionnaire was followed by interviews to better understand the results.

The selection of companies was based on 2010 data and included all national recyclers and the most relevant regional recyclers.

The survey was started in July 2019 when the "Nederlandse Verwijdering Metalelektro Producten" (NVMP), WEEE Nederland, and the Dutch Metal Recycling Federation (MRF) finalized an agreement to compliantly collect and recycle WEEE, known as the MRF Deal. The Deal was implemented in September 2019 and has no effect on 2018 but might have impact on 2019 - 2020. Therefore, the 10 MRF-companies that joined the MRF Deal were contacted again at the end of 2019 to actualize the results. In 2018, most of these companies already had the policy to transfer WEEE to WEEELABEX certified companies.

2.6 WEEE in Waste Bins

The data of WEEE that goes into waste bins is based on a sorting analysis of municipal solid waste (2010 to 2018) that was done by Eureco. The data was provided by Wecycle per UNU-KEY. The amount of WEEE in waste bins has been quantified by stratifying the municipalities into five strata according to the population density (urbanization) degree of the municipality:

1) very strong urban
2) strong urban
3) moderately urban
4) low urban
5) rural

The WEEE in waste bins has been sampled for each stratum per UNU-KEY. Then, a factor per stratum has been calculated for the WEEE kg per inhabitant, per year, and per UNU-KEY. This is then subsequently multiplied with the number of inhabitants in that stratum.

2.7 Export for reuse

The only formal statistics on export for reuse are the voluntary registrations in the NWR, which are 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 validate the numbers. There was not one data source that could entirely describe the exports for reuse with a good coverage of products. Therefore, the following six methods have been used. The outcomes were compared per UNU-KEY. Then the outcomes of the best method per UNU-KEY were chosen. The export for reuse in the 2010 study was based on visual inspections; the results were therefore not transferable (44 kt). Although this data point has been used as a data point for the 2010 data, the outcomes are ranked by data quality. See also the section on results.

Data Source 1: The NWR (high quality)

The NWR did a pilot for registration of Export for Reuse in 2017 and 2018. The results are included in the report "Reportage over 2018"[a]. The data from the NWR was obtained in the categories of the National WEEE Register and was converted into the UNU-KEY. The following conversions were made: Category 2 was completely allocated to UNU-KEY 0204, vacuum cleaner. This allocation has to be refined in the future. However, in 2018, only 114 kg was reported. Category 3b (IT and telecommunications equipment - flat panels) has been allocated to UNU-KEY 0309 (Flat Display Panel Monitors: LCD and LED). The breakdown of category 3c (IT and telecommunications equipment: other household appliances) into the UNU-KEYS was done with the UNU-KEY fractions in mass% obtained from method 2, and resulted in 98.864% allocation to UNU-KEY 0301 (Small IT equipment), 1.037% to UNU-KEY 0302 (Desktop PCs), 0.091% to UNU-KEY 0303 (Laptops) and 0.009% to UNU-KEY 0306 (Mobile phones). Category 3d (IT and telecommunications equipment - other professional appliances) was allocated to UNU-KEY 0307 (Professional IT equipment e.g. servers, routers, data storage, copiers). Category 6 (Electrical and electronic tools) was completely allocated to professional tools UNU-KEY 0602, as it was expected that reuse would occur most for professional tools, and in a lesser extent for household tools (UNU-KEY 0601). Category 10b (Automatic dispensers - non cold) was allocated to UNU-KEY 1001 (non-cooled dispensers).

Data Source 2: Desktop research of previous studies (high quality)

An estimate was made based on other market research. This includes a study on data center equipments with market information provided by Dutch data centers, recyclers, and refurbishers[11] as well as internal data from ICT-Milieu on desktop and laptop refurbishments; the outcomes of this study overlaps with NWR pilot registrations.

Data Source 3: Trade data price analysis: export of mixed new and used EEE (medium quality)

A query was made in Eurostat (the statistical office of the European Union). The selected criteria include the reporter (the Netherlands), the flow (export), and the partners, or importers: (all countries, excluding regions). In Eurostat, the trade data on EEE can include new and used products. Data was downloaded per year from the years 2010 - 2018. Data in Eurostat is reported in the Combined Nomenclature (CN), and the EU's eight-digit coding system is comprised of the Harmonized System (HS) codes with further EU subdivisions. United Nations University converted the UNU Keys to CN Codes. All 784 CN codes linked to EEE were selected in the query. The chosen indicators in the query were the value in Euros and the quantity in pieces. The categories in Eurostat were converted to the required categories (European reporting of WEEE, UNU Keys, and regions). The data was divided per year. The first step was to calculate the average price per piece (per product).

[a] NWR, 2019. see the 2019 report

To prevent incorrect data, values of € 0.00 and € 1.00 were excluded. 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). The second step was to analyze the prices. First, the median price of the average price per UNU Key was calculated. The median was used instead of the mean because outliers and skewed data have a smaller effect on the median than the mean. The median price was not calculated per product code because reviewing the median of all 784 codes was outside the scope of the study. UNU Keys 0301 and 0405 were excluded because of the wide range of (small) products. 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. Second, 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, € 69.00 or less, were assumed to be used. 30% of the median of the price per UNU Key is a relatively low price; there could be more second-hand products, but this share was chosen so that there is more certainty that the products are used.

Finally, the total weight of the products with a price lower than 30% of the UNU Key were summed up for South America, Africa, Asia, Polynesia/Melanesia, and Eastern Europe, as literature shows there is higher export of used products to these regions. The weight was divided in the six European collection categories. The results of the years 2010 - 2018 were compared: the years 2011, 2013, 2014, and 2015 show relatively higher export, but the years 2010, 2012, and 2016-2018 show similar results.

Data Source 4: Trade data: used EEE exported in vehicles (medium quality)

The fourth method is based on the Person in the Port Project[b]. In this study, an actual person inspected the content of containers, vehicles, and import documents of used electronics in Nigeria in 2015 and 2016. 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 EEE, with a used content of 500 kg; and 68% of the trucks contained used EEE, with an average content of 1560 kg. These percentages were applied to the export of used vehicles[c] from the Netherlands to Nigeria and its neighboring countries: Benin, Cameroon, Ghana, and Togo. The conversion to the different product categories were also based on results from the study.

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

Based on an expert judgment, it was decided which UNU Keys are likely to be exported for reuse and grouped into three categories: 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 the medium and high likelihoods. In this step, a low, medium or high fraction has been used. For medium likelihood, the low, medium, and high fraction were respectively 10%, 15%, and 20%. For high likelihood the low, medium, and high fraction were respectively 20%, 30%, and 40%. These percentages applied to the gap of WEEE (WEEE Generated – WEEE collected – WEEE in waste bins). The variation in outcomes have been used as the bandwidth.

Data Source 6: Luca Test Centre (high quality)

There is a warehouse in Amsterdam that is used as a testing facility where inspections and testing of goods are arranged. The pieces of EEE exported for reuse were counted in the test center, and the weight was calculated by using the average weights from the UNU Keys. 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.

Integration of data sources

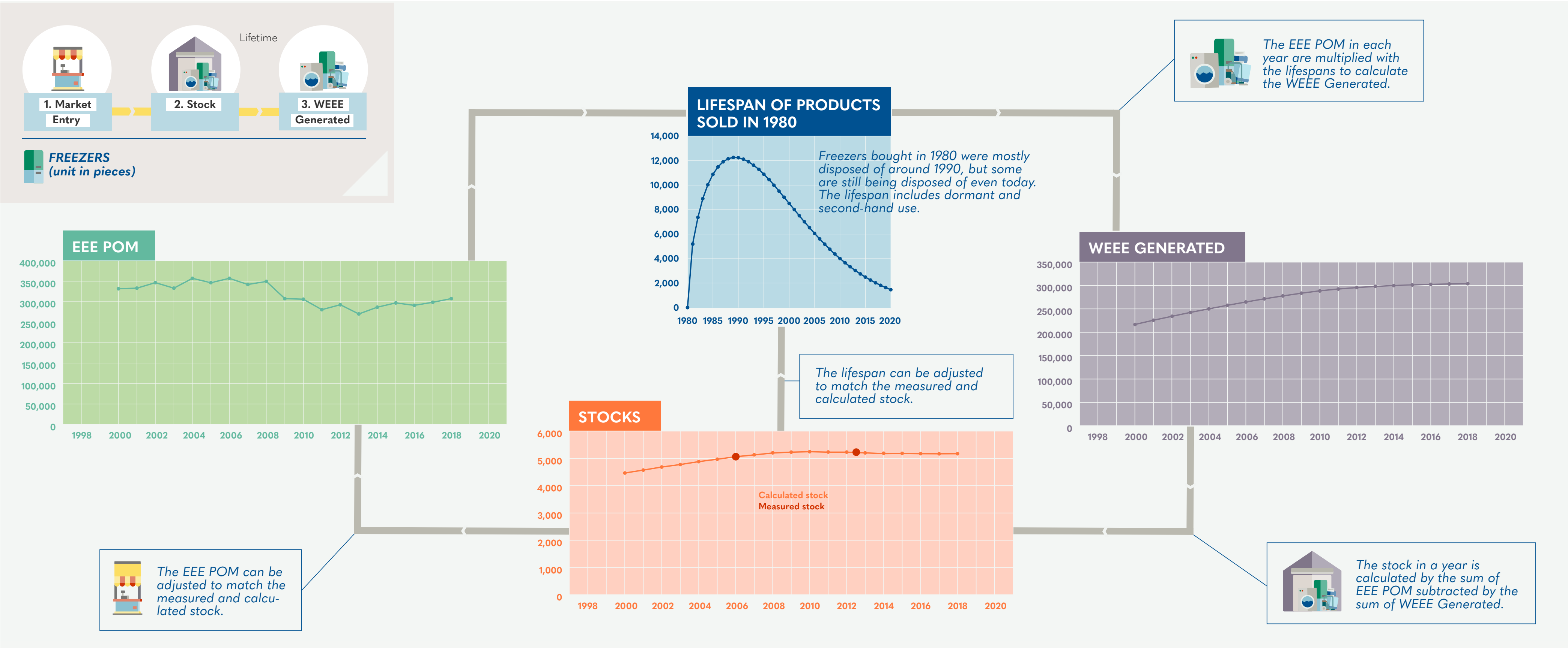
If it was suspected that datasets had an overlap, the highest value was taken to avoid double counting. If there is only one data point available, that value has been used.

(b) Person in the Port Project, 2017. visit website
(c) In Eurostat, used vehicles have a different CN code than new vehicles.

2.8 Sales-Stock-Flow Modelling

In sales-stock-flow modelling, a consistent dataset is made by creating mathematical relations between two empirical datasets. In this study, several sources of EEE POM data, their lifespans, and the stock of appliances in businesses and households were available. As a first step, a time series of sales from 1980 to 2018 was analyzed. The lifespan was based on literature. As a second step, a stock can be modelled from that EEE POM and lifespans. The EEE POM or lifespans are then iteratively adjusted in such a way that the modelled stock matches the measured stock. In this iterative approach, certain boundaries need to be respected, such that the lifespan can't deviate too much from the measured one, as that is probably not realistic. In other cases, if needed, the EEE POM time series has to be adjusted by replacing it with another data source, or manually replacing some outliers in the time series.

FIGURE 10. SALES-STOCK-FLOW MODELLING



Chapter 3. Results

3. Results

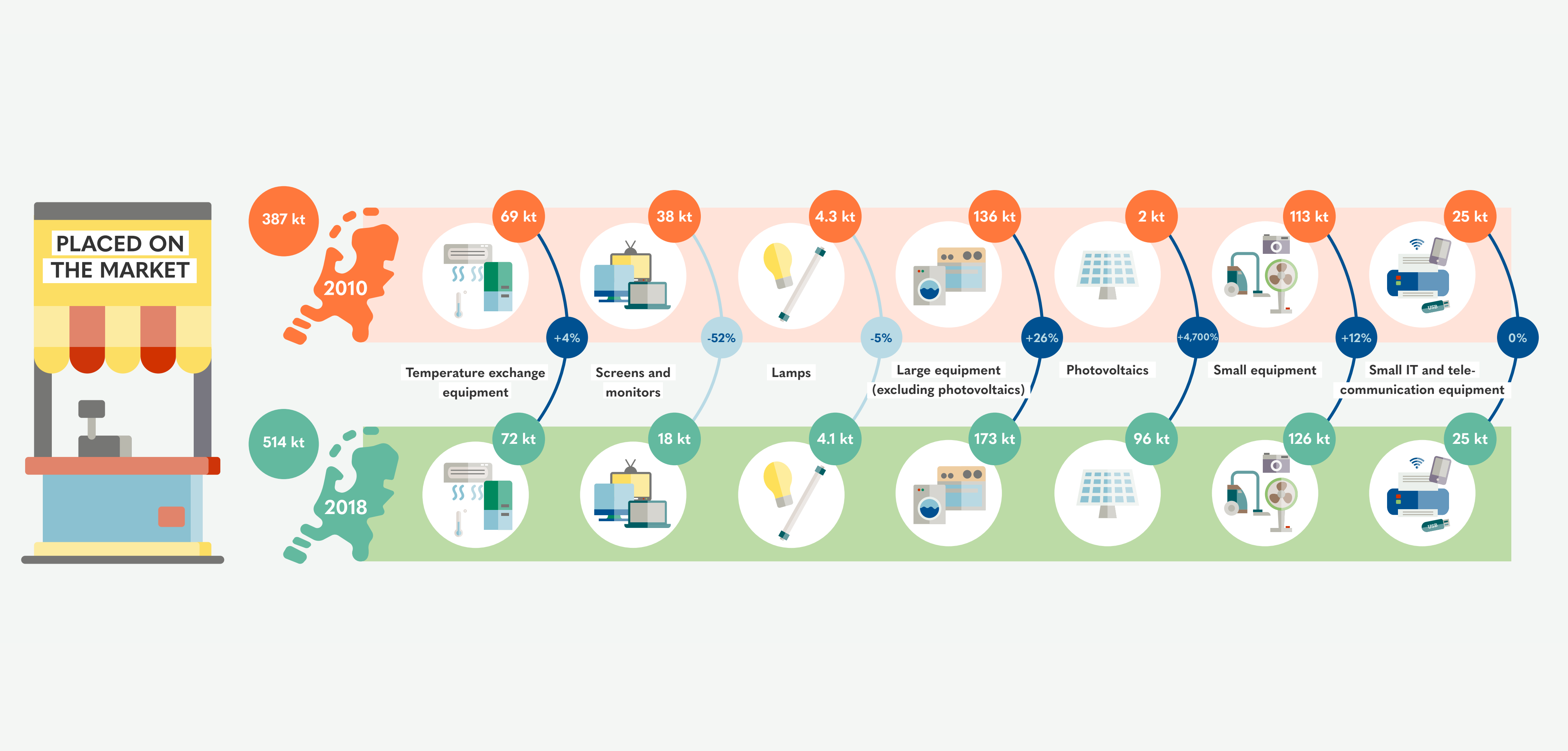
This chapter will discuss the results for each WEEE Flow in 2018, and the data from 2018 will be compared to the data from 2010.

EEE POM

The total EEE POM in 2018 is 514 kt, consisting of large equipment (34%), followed by small equipment (24%), PV Panels (19%), temperature exchange equipment (14%), small IT (5%), screens (3%), and lamps (1%). The difference between the EEE POM in 2010 and 2018 is illustrated in Figure 11[d]. Between 2010 and 2018, the EEE POM increased by 127 kt (33%), from 387 kt to 514 kt. The figure shows that there is a high decrease in the category screens. This can be explained by the decrease in cathode-ray tube (CRT) screens that have a relatively high weight.

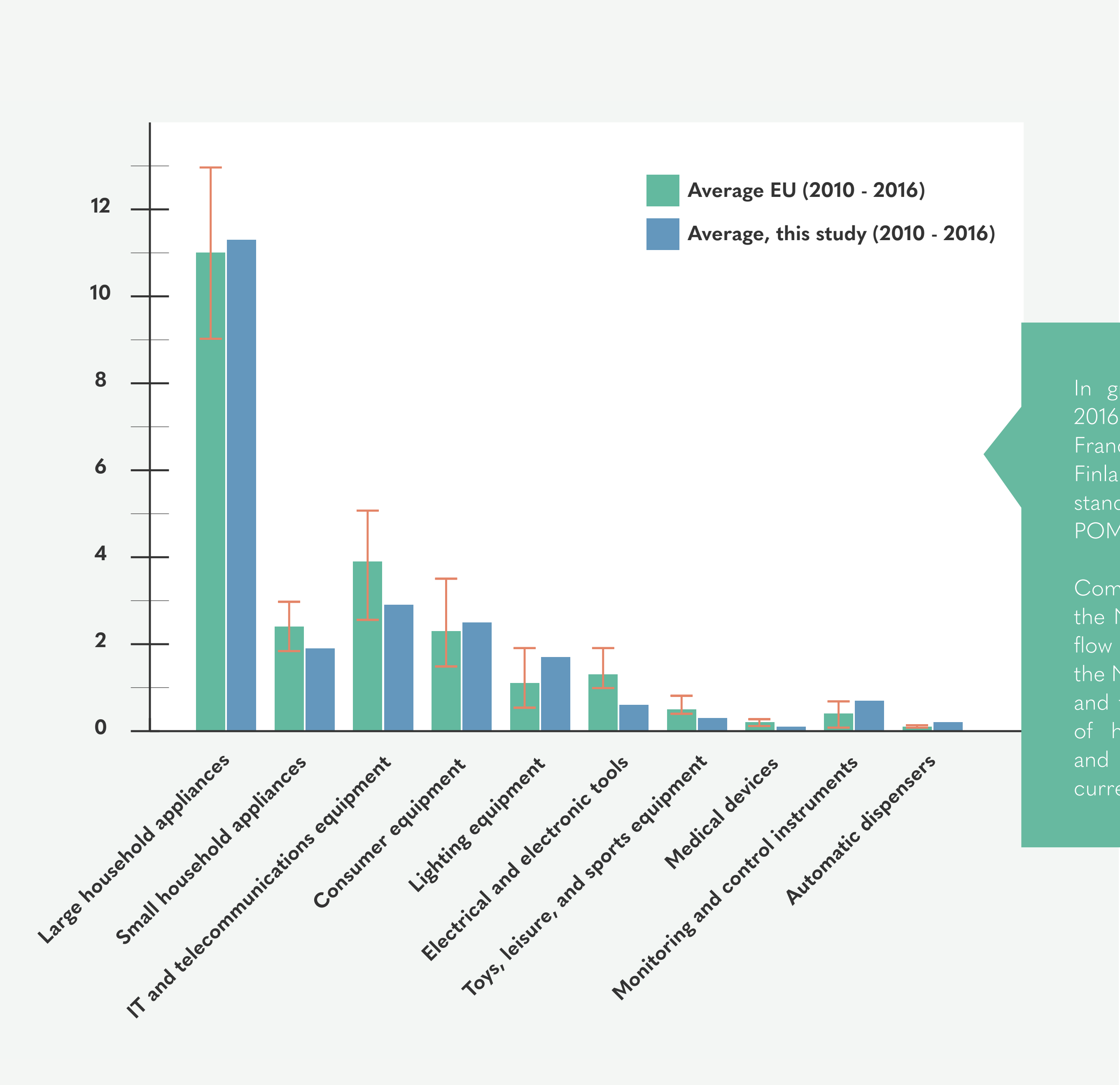
There is a large increase in large equipment and in PV panels. The PV Panels increased between 2010 and 2018 by 94 kt. Excluding PV panels, there was only an increase of 33 kt (8%).

FIGURE 11. EEE POM IN 2010 AND 2018



(d) In Annex II, an overview table of the EEE POM 2010-2018 per category can be found.

FIGURE 12. BENCHMARK OUTCOMES EEE POM WITH EU WEEE DIRECTIVE DATA BETWEEN 2010-2016



The EEE POM outcomes of this study were compared to the reporting of EEE POM for the WEEE directive in other countries in the European Union, for the period from 2010 to 2016. The EEE POM in the Netherlands are in the same range of the average and standard deviation of comparable countries in the 10 categories. It should be noted that the EEE POM in the data from Eurostat could have contained some sales of CRT monitors, which were already completely replaced by lighter flat panel monitors. Therefore, the EEE POM for IT goods are significantly lower than the EU benchmark.

In green: average POM data from 2010 to 2016 for Belgium, Denmark, Germany, Ireland, France, Luxemburg, the Netherlands, Austria, Finland, Sweden, and Great Britain, with standard deviation as an error bar. In blue: the POM from this study.

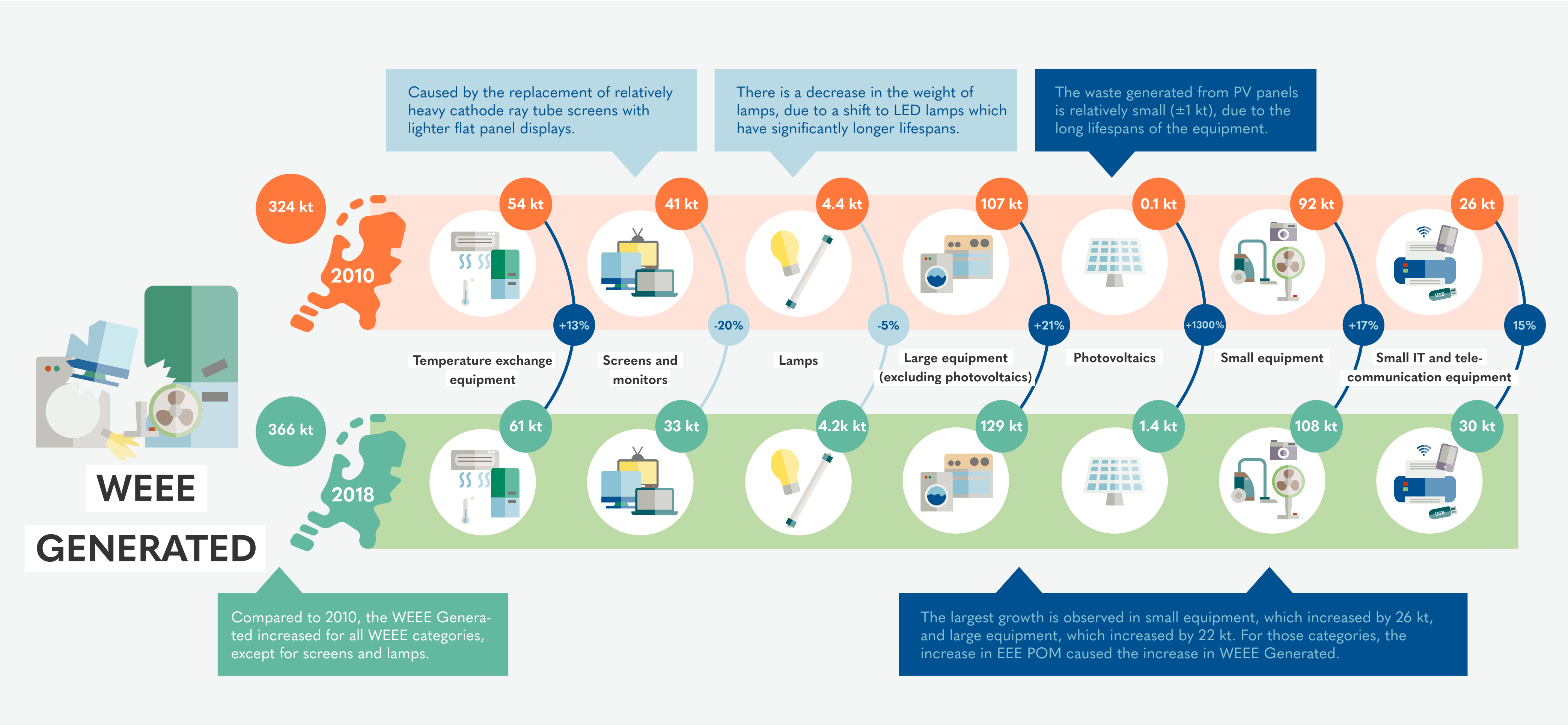
Comparing the data on EEE POM registered in the NWR and the outcomes of the sales-stock-flow modelling, a large gap was found between the NWR data for the Small equipment category and this study (27 kt). This gap consists mainly of household luminaires, music equipment, and speakers. The household luminaires are currently not registered in the NWR.

3.2 WEEE Generated

The WEEE Generated in 2018 was 366 kt, ~71% of the EEE POM. The WEEE Generated also consists mainly of large equipment and small equipment (65%), followed by temperature exchange equipment (17%), screens (9%), small IT (8%) and lamps (1%), and PV Panels (less than 1%). PV Panels are relatively new on the market and are not yet present in waste streams.

The difference between the WEEE Generated in 2010 and 2018 is illustrated in Figure 13[e]. Between 2010 and 2018, the WEEE Generated increased by 42 kt (13%) from 324 kt in 2010 to 366 kt in 2018 – a relative strong increase compared to the increase in EEE POM excluding PV panels. This includes an increase of large and small equipment and temperature exchange equipment, but it also includes a small increase of PV panels WEEE. On the other side, there is a large decrease in screens. This can also be explained by a decrease in the quantity of cathode-ray tube screens and an increase in flat panel displays, which have a much lower weight. As shown in the data, the amount of screen is expected to decline due the replacement of heavy cathode-ray tube screens with flat panel displays. Small IT (e.g. mobile phones) is expected to grow less quickly due to miniaturization of the products.

FIGURE 13. WEEE GENERATED IN 2010 AND 2018



[e] In Annex II, an overview table of the WEEE Generated 2010-2018 per category can be found.

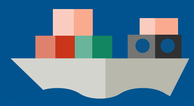
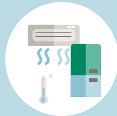
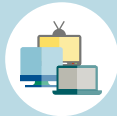
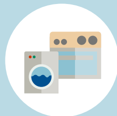
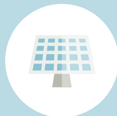
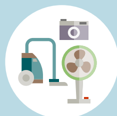
3.3 Export for reuse

In the previous study, an estimate was made based on visual inspections by inspection authorities, in which 44 kt of used EEE exports have been reported. This methodology could not be replicated. Therefore, other data sources have been used. Based on the different methods, the export for reuse is estimated to be 31 ± 14 kt in 2010.

For 2018, the export data reported in the NWR are on a voluntary basis and only amount to 3 kt. Of this weight, 2.8 is small IT and 0.1 kt is large equipment. As described in the methodology, five other methods were used to calculate the export of reused EEE from the Netherlands. The outcome of the second method (desktop research) is export of 8 kt to 25 kt of used EEE. The outcome of the third and fourth method (based on trade statistics) is export of 17 kt of used EEE. The outcome of the fifth method (the analysis of reusability of UNU Key product groups) is export of 13 kt to 26 kt used EEE. The results from the Luca test centre is export of 2.4 kt of used EEE. When all data is integrated, and corrected for double counting, it was calculated that 31 ± 2.3 kt of used EEE was exported in 2018.

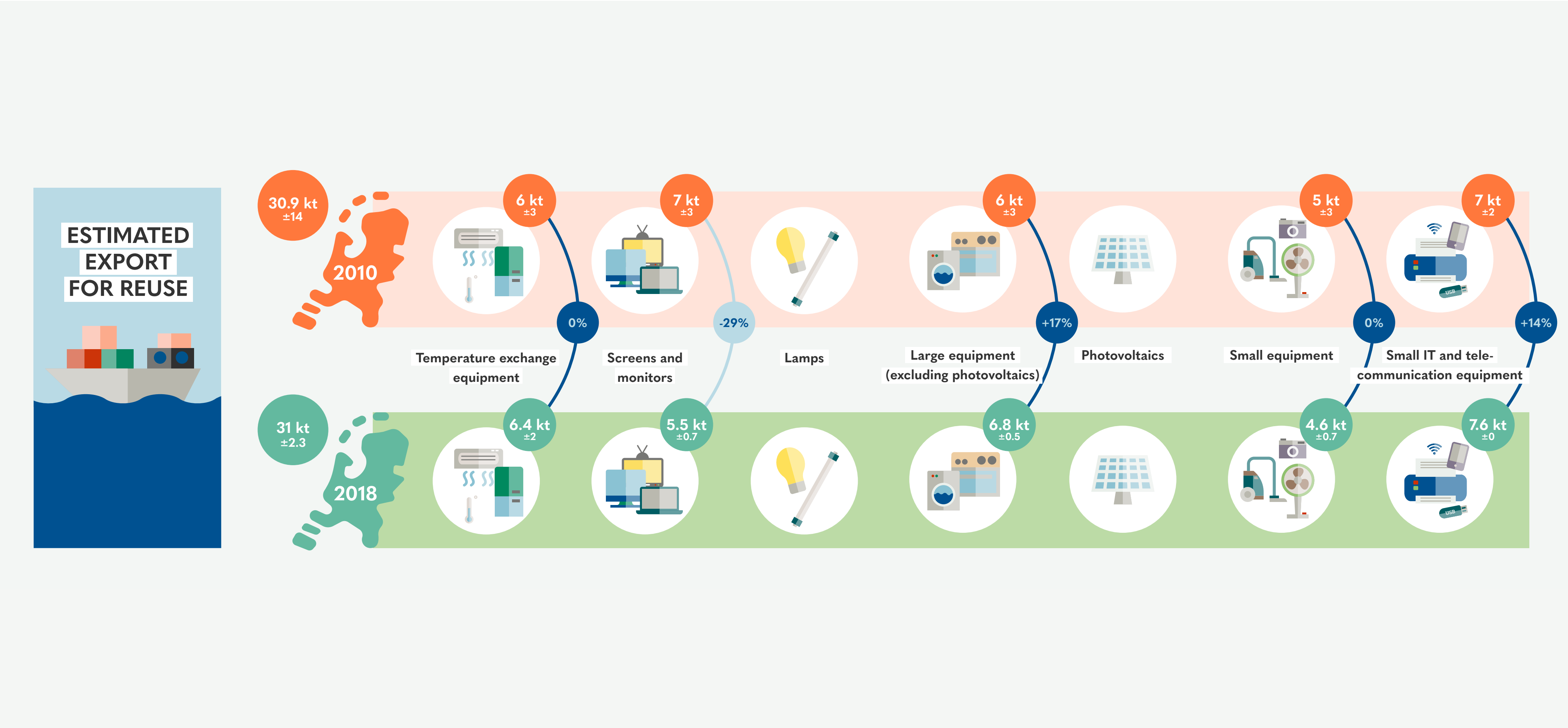
The outcomes are then ranked by data quality, in which the LUCA, desktop research, and data from the NWR were ranked as being of "high quality". The data based on a model with trade data (methods 3 and 4) were ranked as "medium quality", and the data based on the expert guess (method 5) were ranked as "low quality". As a first step, the "high quality" data was allocated to high quality. Then "medium quality" data was calculated by subtracting the "high quality" data point from the "medium quality" data point. As a final step, the "low quality" data point was calculated by subtracting the data from "high and medium quality". Any double countings were taken out. These steps were performed per UNU-KEY and were calculated such that the results per data quality in table 3 add up to the total.

TABLE 3. DATA QUALITY EXPORT FOR REUSE

	HIGH QUALITY	MEDIUM QUALITY	LOW QUALITY	TOTAL
	1.5	0.5	4.4	6.4
	0.5	3.0	1.9	5.5
	-	-	-	-
	4.9	0.4	1.5	6.8
	-	-	-	-
	-	2.8	1.8	4.6
	3.1	4.5	-	7.6
TOTAL	**10.1**	**11.1**	**9.7**	**30.9**

Results from the different methods, ranked by quality in the 6 EU categories in kt. Some numbers in the graph do not match the total due to rounding.

FIGURE 14. ESTIMATED EXPORT FOR REUSE IN 2010 AND 2018



WEEE exports

Though there is no data available on how much WEEE is illegally exported from the Netherlands, in several studies, it was estimated that 20% to 30% of the exported used EEE is not functional and is therefore equivalent to WEEE (the CWIT Project[12], Person in the Port study[13], E-waste country assessment Nigeria[14], and the Technical Report of the Dutch WEEE Flows 2011[3]).

In the Person in the Port study was concluded that on average 19% of the 760 tested used electronic were non-functional. The non-functional equipment was composed of: microwaves, radios and cookers (10%-15%); refrigerators, DVD-players and air conditioners (30%-40%) and mobile phones and LCD TVs (50%-55%).

In the Luca Test Centre, 2% of the used EEE was disqualified and was thus WEEE. This percentage is likely to be low because the exporters are aware it is a test center, and such will ensure not to export non-functioning (illegal) products. Possible additional WEEE Flows passing through transit countries such as Belgium and Germany could not be calculated with the current data.

3.4 Waste Bins

The sorting analysis of municipal solid waste (2010 to 2018) that was carried out by Eureco shows that WEEE in waste bins decreased between 2010 and 2018 by approximately 10%, from 36 kt to 33 kt (see Figure 15). This is 9% of the total WEEE Generated, and is mostly comprised of small IT, lamps, and small equipment (75%). The observed decrease in particular was caused by the decrease of small IT, which declined by 60%, from 12.9 kt to 5.2 kt. Lamps and small equipment slightly increased.

FIGURE 15. WEEE IN WASTE BINS (EURECO, 2018) (IN KT)

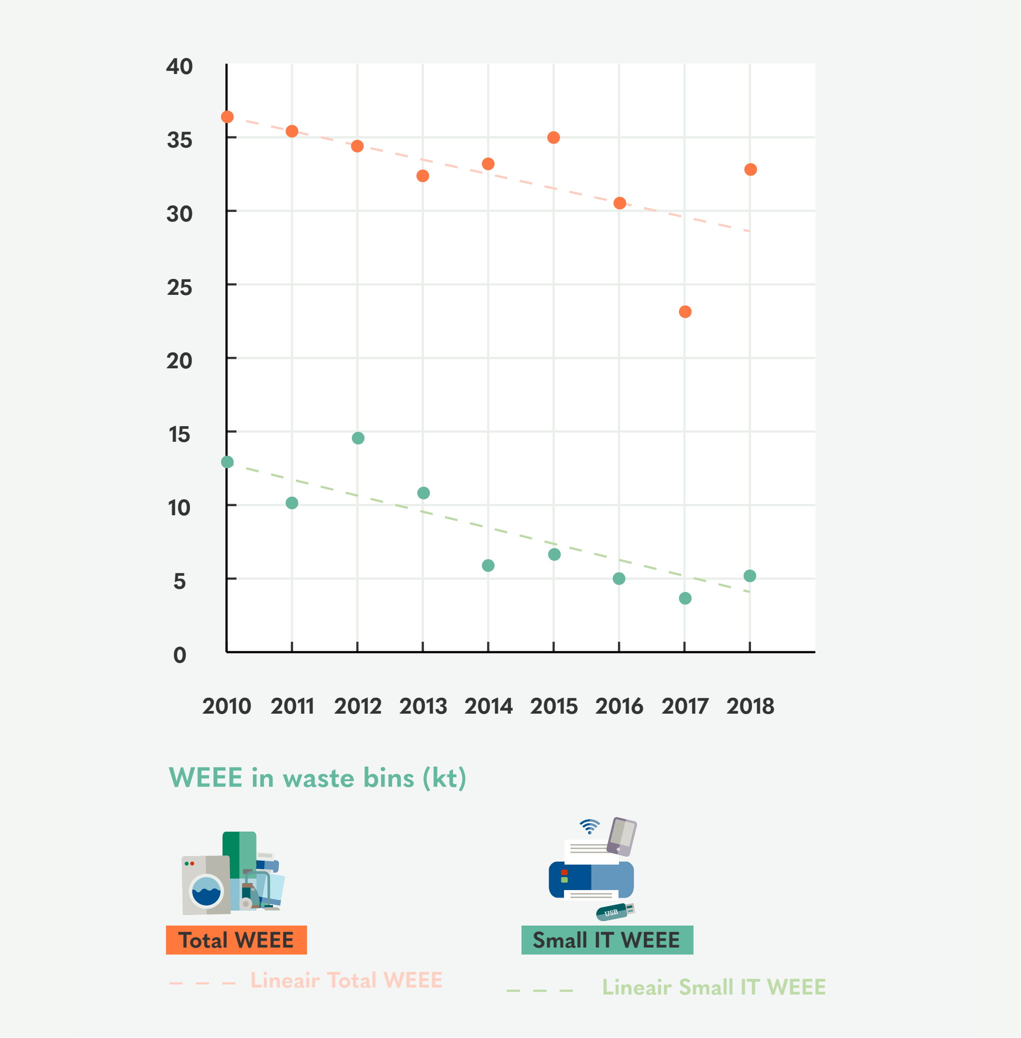
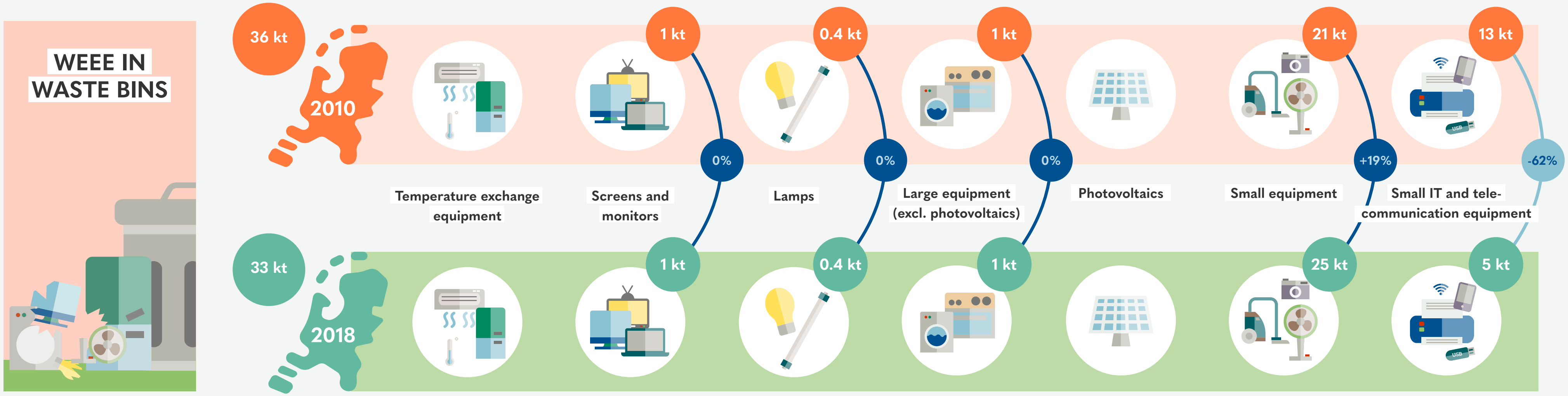


FIGURE 16. WEEE IN WASTE BINS



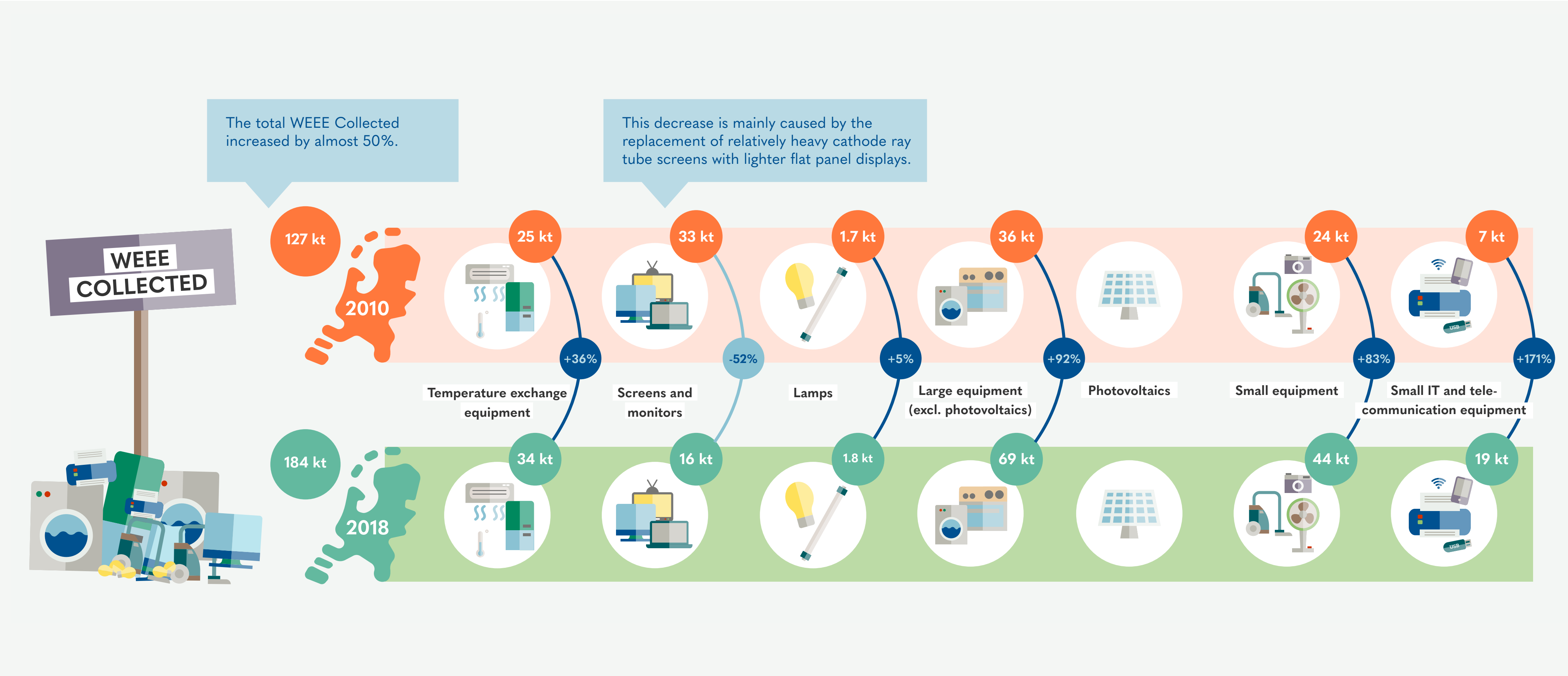
Compared to 2010, WEEE in waste bins decreased by approximately 10% from 36 kt to 33 kt. The decrease was primarily caused by the decrease of small IT, which declined by 60% from 12.9 kt to 5.2 kt.

3.5 WEEE Collected

The total WEEE Collected in 2018 is 184 kt. The largest percentage of this is large equipment (38%), followed by small equipment (24%), temperature exchange equipment (18%), small IT (10%), screens (9%), lamps (1%), and PV Panels (<1%).

The difference between the WEEE Collected in 2010 and 2018 is illustrated in Figure 17[g]. WEEE Collected shows a stronger increase, compared to WEEE Generated, with a 57 kt (45%) increase from 127 kt to 184 kt between 2010 and 2018. The collection of screens category decreased from 33 to 16 kt from the years 2010 - 2018, due to the shift from heavy CRT screens to lighter flat panels displays. There is (almost) a doubling in collection of small equipment (24 kt to 44 kt), large equipment (36 kt to 69 kt), and small IT collected (7 kt to 19 kt). The collection of lamps has been relatively stable.

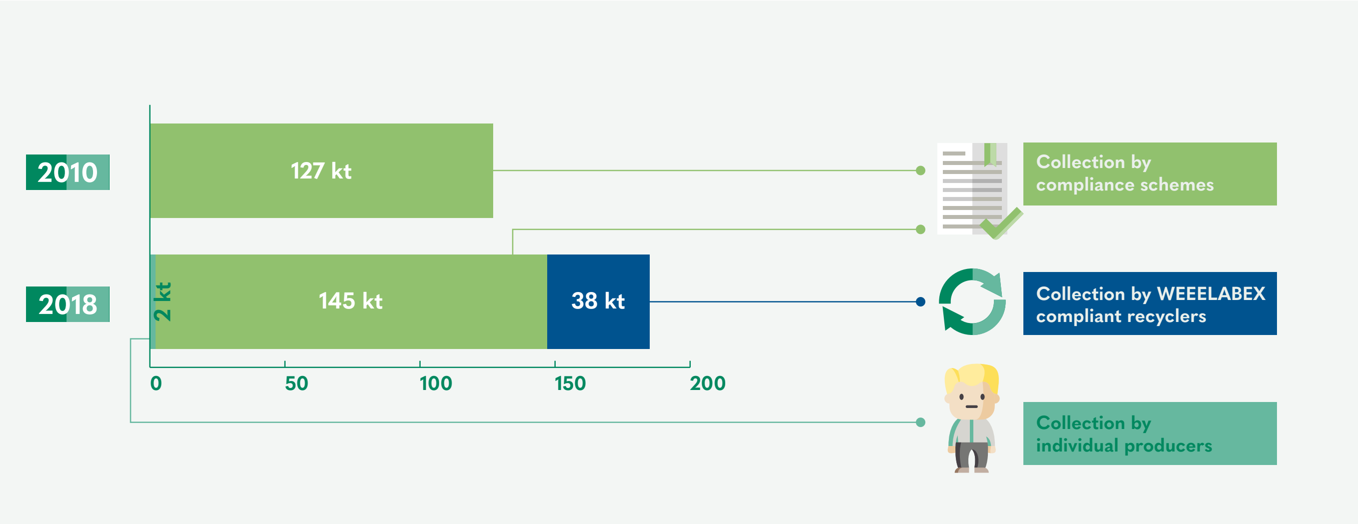
FIGURE 17. WEEE COLLECTED IN 2010 AND 2018



[g] In Annex II, an overview table of the WEEE Collected 2010-2018 per category can be found.

Figure 18 shows a graph of the WEEE Collected by compliance schemes and WEEELABEX compliant recyclers. In 2010, all WEEE was collected by the WEEE compliance scheme. Since 2015, recyclers have been reporting to the NWR. The WEEE Collected by compliance schemes increased from 127 kt to 145 kt, and an additional 38 kt was reported by WEEELABEX compliant recyclers.

FIGURE 18. WEEE COLLECTION SPECIFIED BY TYPE OF ORGANISATION IN 2010 AND 2018 (KT)



Some numbers in the graph vary slightly from those in the text, due to rounding.

3.6 Complementary recycling of WEEE

The quantity of complementary flows — non-compliantly recycled WEEE — was planned to be obtained from the survey using a questionnaire for 2018 data that was sent to 26 metal scrap and WEEE recyclers in July 2019. Most recyclers responded to the survey, but very few recyclers could provide data for the quantities of complementary recycled WEEE. They responded that it could be that WEEE Flows are still incorporated in mix flows, but only as a minor percentage (approx. 0.5% pollution), which is accepted by WEEELABEX-recyclers for treatment. The mix flows are not registered as WEEE. A 0.5% WEEE contamination would only amount to approximately 5 kt of unregistered WEEE treatment. Additionally, they responded that WEEE Flows can still be accepted in mixed 'pre-shredder' flows by non WEEELABEX-recyclers or can be exported towards foreign recyclers, most likely in Belgium or Germany. It became also clear from the survey that WEEELABEX has led to more transparency in "monoflows" of WEEE. This is supported by the increased amount of WEEE that has been registered in the NWR.

Despite this, the gap — i.e. the amount of WEEE Generated minus WEEE Collected, Waste Bins and Export for Reuse — was 118 kt in 2018 and had been 130 kt in 2010. Thus, it is approximately in the same order of magnitude.

The economic drivers, as well as the sources of complementary flows — the grey circuit — have likely not changed since 2012. Thus, large amounts of WEEE are still traded and not registered. A fundamental change in the WEEE market is required to capture those flows. The introduction of WEEELABEX has changed the opportunities for estimating and calculating complementary flows in comparison to 2012. It is likely that the weight of complementary flows for 2018 may have slightly decreased since 2010, due to the shift to WEEELABEX recycling. However, complementary flows are still present in the market and have a significant market share. The gap between WEEE Generated and the sum of the WEEE Flows that could be documented (WEEE collected in NWR + WEEE in Waste Bins + Export for Reuse) remains at 118 kt. In 2010, 110 kt of the 130 kt, or 84%, was attributed to non-compliant recycling, based on the survey. Based on interviews with metal traders and recyclers, we estimate that the same percentage of the gap was still recycled in 2018. This implies that 84% * 118 kt = **100 kt is still traded or mixed in with other waste streams** or finally is still exported towards foreign recyclers, most likely in Belgium or Germany, and not registered in the NWR.

At the end of 2019, the 10 MRF-associated companies that joined the MRF-deal were asked by FFact if this instrument, i.e. a compensation of €50 per tonne of WEEE transferred to a WEEELABEX recycler, would increase the WEEE registration. We obtained annual estimates based on the first four months as presented in table 4. From the response of the MRF-associated companies, we indicate an increase in the annual

TABLE 4. ANNUAL ESTIMATES BASED ON THE FIRST FOUR MONTHS FOR THE MRF-DEAL

MRF-ASSOCIATED COMPANY	WEEE TRANSFERRED FOR MRF-DEAL	COMMENTS
1	no increase	WEEELABEX Certified
2	no increase	WEEELABEX Certified partner organisation
3	little increase	Policy to transfer WEEE already in place
4	15	
5	50	
6	60	
7	100	
8	100	
9-10	no indication	Probably same magnitude, but no quantification
Total	< 1000 tonnes	Additional registration compared to 2018

collected and registered weight of WEEE of less than 1 kt. Individual metal recyclers report transferred weights between 15 and 100 tonne/y. Besides the estimated results of the MRF-deal, the metal companies reported that in 2019, the enforcement of WEEELABEX and corresponding dedicated inspections was enhanced. This also stimulates additional registration.

In most cases, the companies that joined the MRF-deal had already adopted a policy to not accept WEEE or only accept WEEE to be transferred to WEEELABEX Certified recyclers before July 2019. The MRF is currently stimulating companies to join the MRF-deal. There is no threshold because all standards for acceptance and handling of WEEE are incorporated in the MRF-label and quality check.

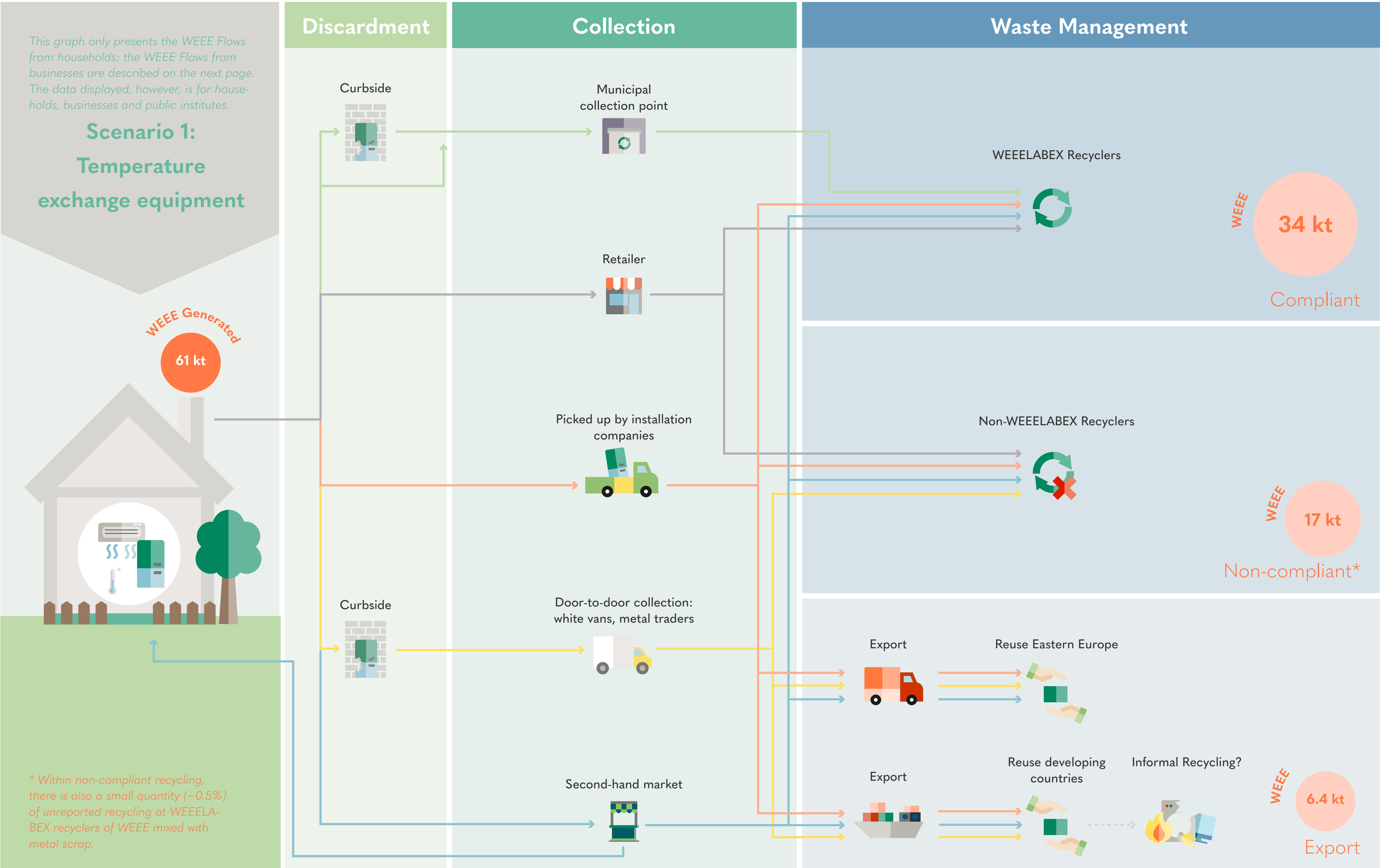
Chapter 4. Discussion: WEEE Flows per Category

To illustrate and discuss the results of this study, we present scenarios for each of the six categories in the WEEE Directive (Figure 6.):

1. Temperature exchange equipment
2. Screens
3. Lamps
4. Large equipment
5. Small equipment
6. Small IT

Each scenario shows the type of products in the category, how much WEEE is generated, where and by whom the WEEE are collected, and how it is managed.

FIGURE 19. SCENARIO: TEMPERATURE EXCHANGE EQUIPMENT (TEE)



Scenario 1: Temperature exchange equipment (TEE)

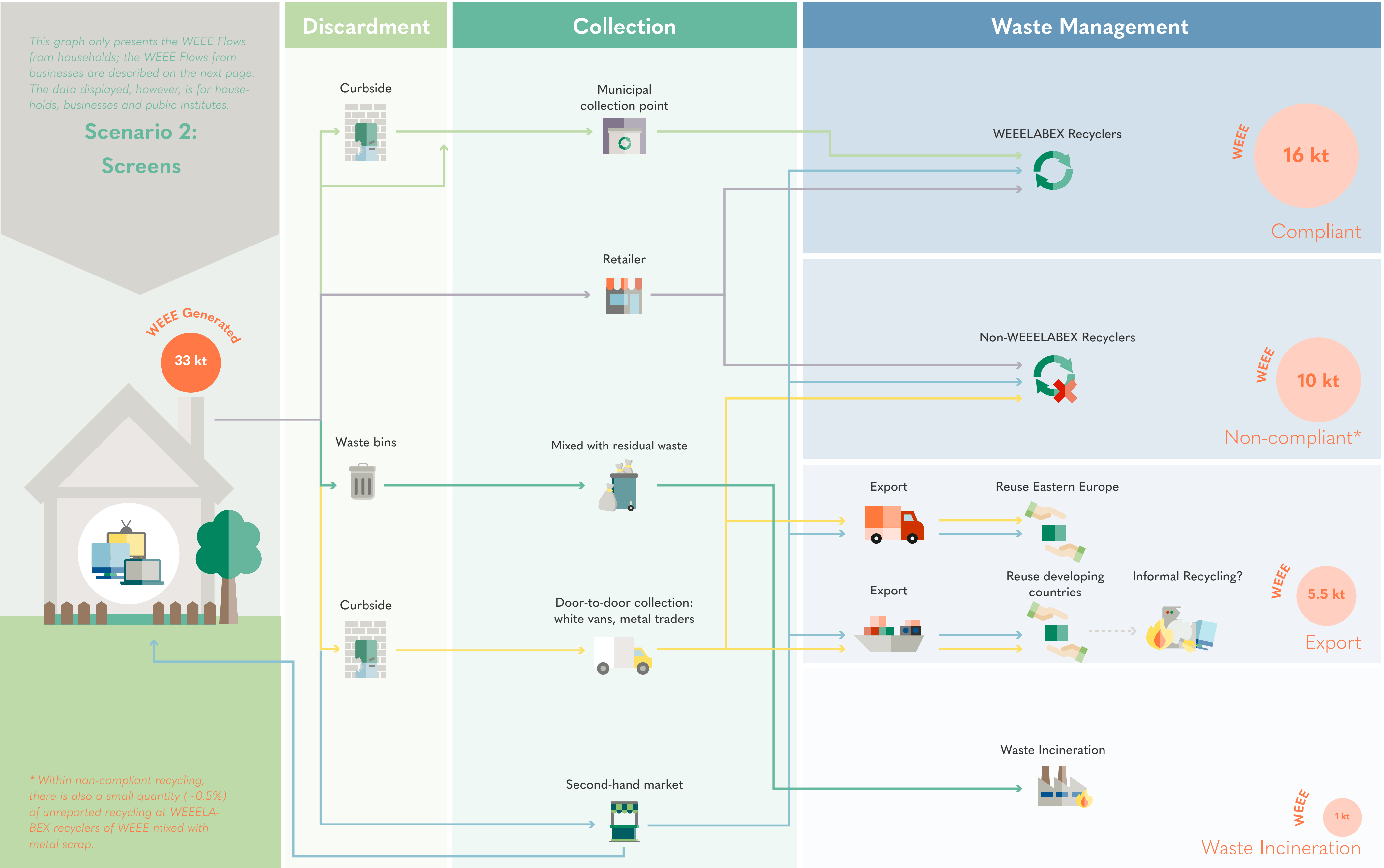
In 2018, a total of 72 kt of temperature exchange equipment (TEE) was placed on the market, and 61 kt of TEE waste was generated. This includes products for households such as freezers, fridges, air conditioners, and large cooling and freezing products for businesses such as supermarket cooling displays.

The TEE waste from households was collected by municipal collections points, retailers, installation companies, charity, refurbishment, and informal waste collectors (which includes scavenging). TEE waste from businesses was collected by professional collection companies. The TEE waste was managed by compliant recyclers (34 kt) and exported for reuse (6.4 kt), and some waste was managed by non-compliant recycling (17 kt). The non-compliantly recycled WEEE can also include export flows to foreign recyclers, most likely in Belgium or Germany.

TEE has the following characteristics that impact the collection and management of the waste:

- TEE is large in size and weight. Therefore, these are not collected by supermarkets and hardware stores. Because of their size and weight, they are often put on the curbside either to be collected by the municipality or to be dumped (estimated 9 kt). The dumped equipment can be collected by non-compliant waste managers (17 kt) or linked to export for reuse.
- Temperature exchange equipment contain valuable materials. Valuable parts are scavenged from a fridge (such as cutting off the compressor), or TEE is collected by entire units and brought to a non-compliant recycling route or prepared for export. The products contain metals and might be mixed, after scavenging or cutting, with regular metal scrap (called pre-shredder or refined metal scrap).
- Temperature exchange equipment often have a lifespan extension option. They are brought to charity/second-hand stores and are exported for reuse. Fridges were observed to be exported to developing countries in second-hand cars, as well as in containers mixed with other used EEE and WEEE. Used fridges were also collected from the curbside and driven in small vans to other countries in the EU.
- Furthermore, there are specific environmental impacts associated with TEE. During non-compliant recycling, toxic materials such as ozone-depleting substances from old refrigerants and greenhouse gases of the new refrigerants might be released in the open air.

FIGURE 20. SCENARIO: SCREENS



Scenario 2: Screens

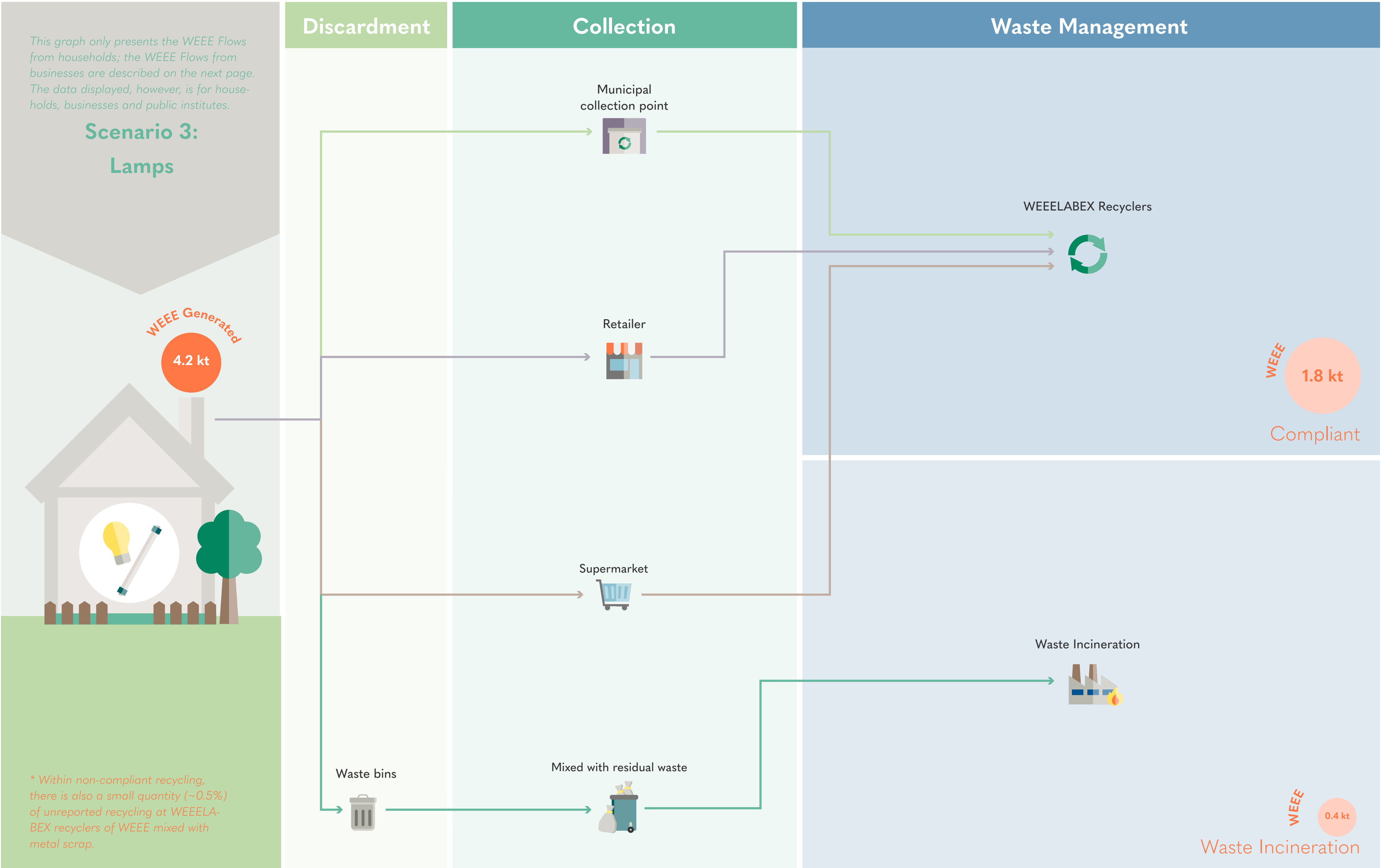
In 2018, 18 kt of screens were placed on the market, and 33 kt of screens waste was generated. The screens placed on the market includes flat panel televisions, monitors, laptops, and tablets. The screens waste generated is comprised of both flat panel displays and CRT displays, as well as laptops and tablets.

The screen waste was collected by municipal collection points, retailers, or charity, refurbished, or disposed of in waste bins and was collected by informal waste collectors. Screen waste from businesses was collected by professional collection companies. The screens were managed by compliant recyclers (16 kt) and exported for reuse (5.5 kt), the WEEE in waste bins was incinerated (1 kt), and the screens were non-compliantly recycled (10kt). The non-compliantly recycled WEEE can also include export flows to foreign recyclers, most likely in Belgium or Germany.

Screens have the following characteristics that impact the waste's collection and management:

- Size and weight: screens are generally not collected by supermarkets and hardware stores. Though they have a relatively larger size, approximately 1 kt of laptops are found in waste bins. This has been constant since 2010.
- The lifetime of screens can easily be extended: laptops can be bought from enterprises, then cleaned of their content and, if needed, refurbished, after which they can be sold nationally (lifetime extension) or abroad (export for reuse). Screens can be exported in cars or containers to Africa for second-hand use. Used EEE may contain a considerable percentage of non-working equipment, or screens can be broken during transport, upon which they should be considered WEEE. Screens are collected curbside by white vans to be exported to other EU countries.
- Valuable material: non-compliant recycling of screens is calculated at 10 kt. This is still a considerable part of WEEE Generated. Especially the more valuable new type of screens (LED) might not be recycled by certified recyclers because of the trade value.

FIGURE 21. SCENARIO: LAMPS



Scenario 3: Lamps

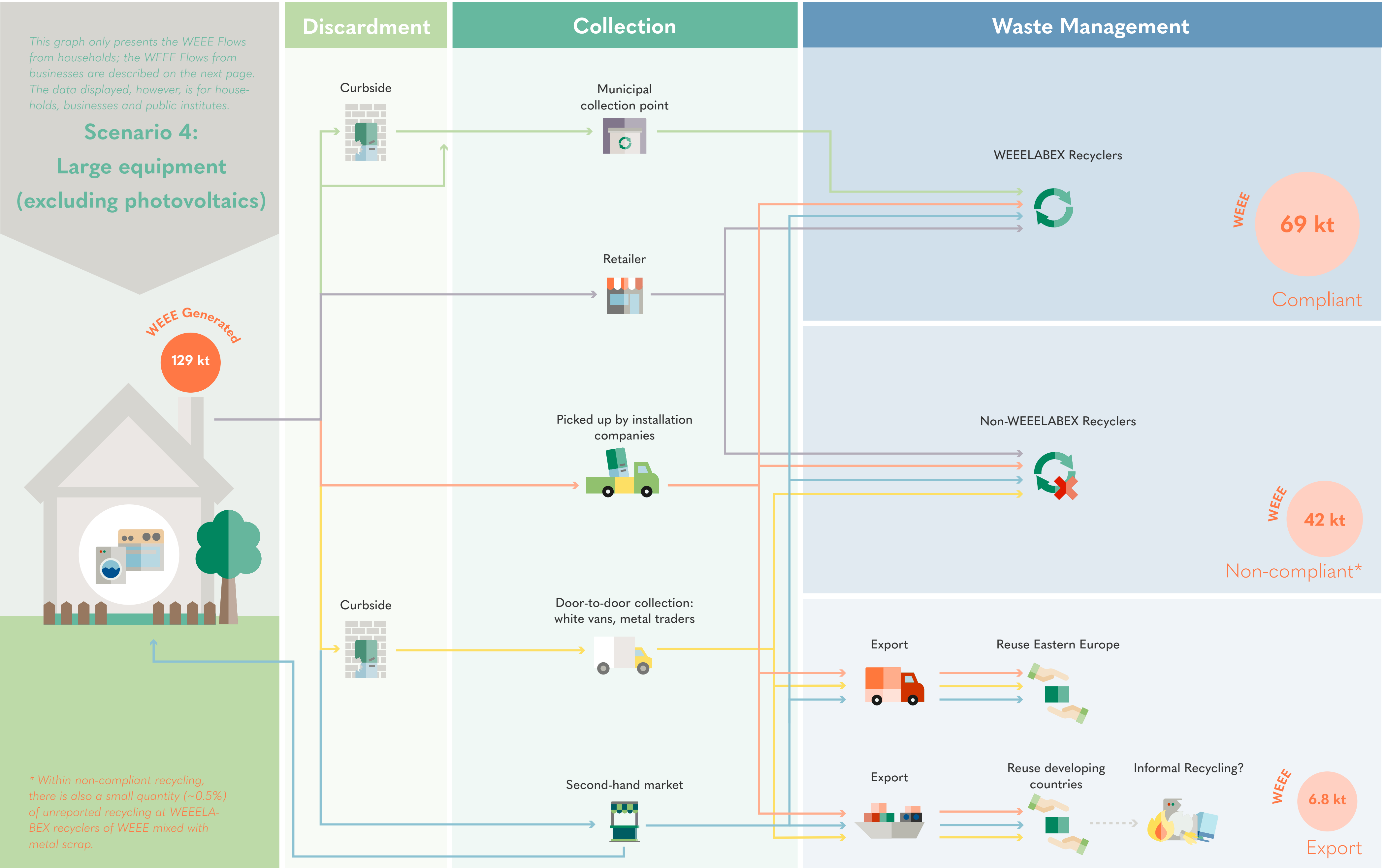
In 2018, 4.1 kt of lamps were put on the market, and 4.2 kt of waste from lamps were generated. As this WEEE Generated from lamps is approximately the same as the EEE POM of lamps, the market is currently a replacement market. Lamps include straight tube fluorescent lamps, compact fluorescent lamps, and small lighting equipment (such as Christmas decorations, bicycle lights, and flashlights).

The lamp waste was collected by municipal collection points, supermarkets, retailers, disposed of in waste bins, and collected by informal waste collectors. Lamp waste from businesses was collected by professional collection companies. In total, 1.8 kt was managed by compliant recyclers, and 1.8 kt and 0.4 kt, respectively, were incinerated. There was 2 kt of undocumented flows. The whereabouts of 50% of WEEE Generated could not be traced in this study.

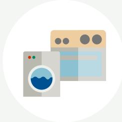
Lamps have the following characteristics that impact the collection and management of the waste:

- Material composition: lamps have a negative value due to their low average weight, and low valuable material content. Thus, most of the collected lamps are handed over to WEEELABEX compliant recyclers, where they are depolluted and recycled.
- Size: Since lamps are relatively small, and due to the fact that not all consumers are aware of the negative environmental impact of lamps, lamps are also disposed of in waste bins. This has been constant since 2010.

FIGURE 22. SCENARIO: LARGE EQUIPMENT



Scenario 4: Large equipment



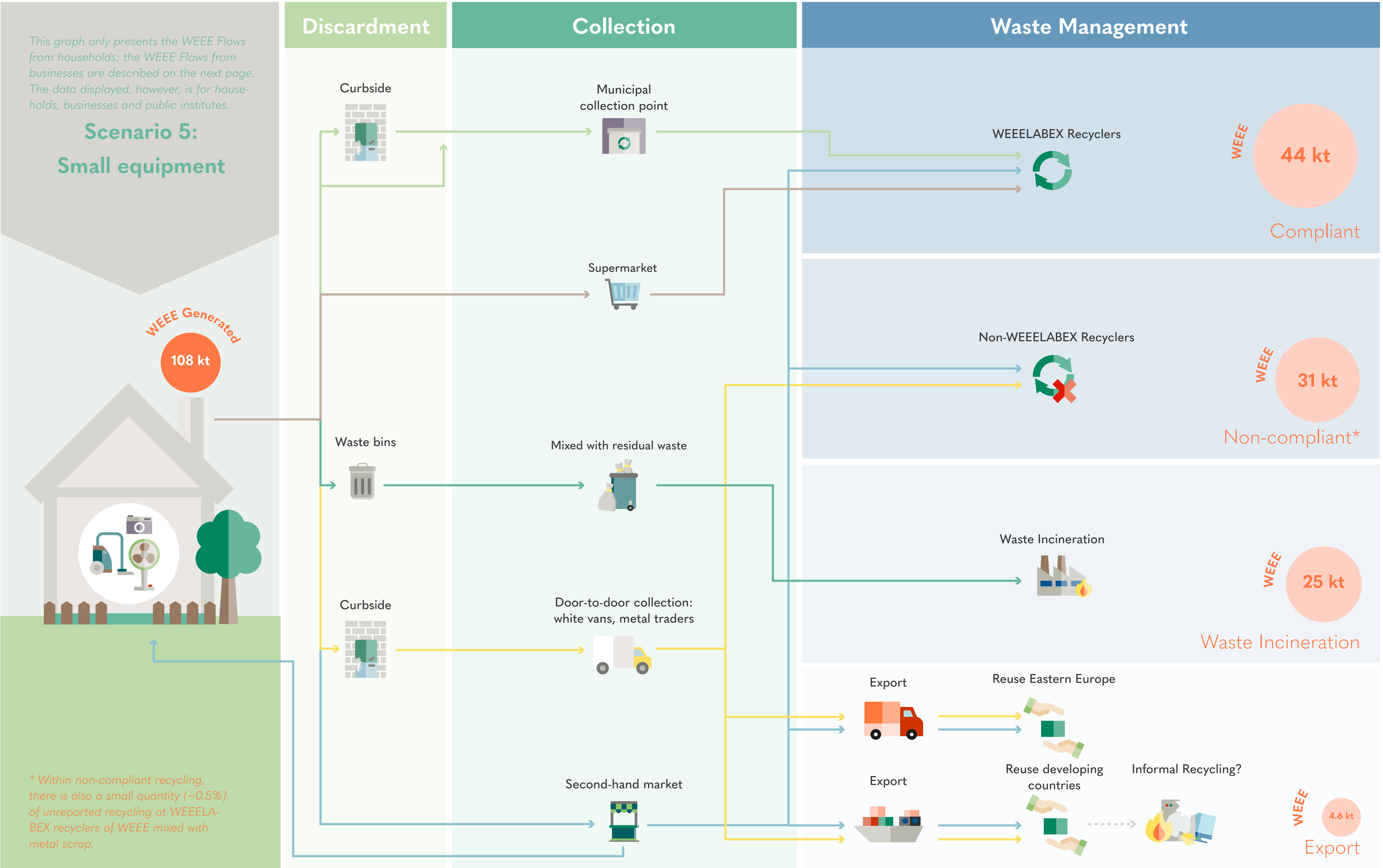
In 2018, 173 kt of large equipment was placed on the market and 129 kt of large equipment were generated plus 1.4 kt of PV Panels. In households, this includes products such as central heating, dryers and furnaces. It also includes professional equipment such as large printers and medical equipment.

The large equipment waste was collected by municipal collection points, retailers, installation companies, charities, and informal waste collectors, or was refurbished. The large equipment waste from businesses was collected by professional collection companies.

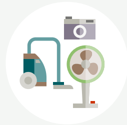
The large equipment waste was managed by compliant recyclers (69 kt) and was exported for reuse (6.8 kt), and there is an estimated 42 kt of non-compliantly recycled. There is still 10.2 kt of undocumented flows. The non-compliantly recycled WEEE can also include export flows to foreign recyclers, most likely in Belgium or Germany.

- Lifetime distribution: Large equipment is sometimes discarded by households prior to the end of the equipment's technical lifespan. These appliances can be shipped to poorer regions of the world, where a demand exists for used equipment. In such cases, the equipment is put in containers or in second-hand cars, trucks, and buses that are shipped to Africa and Asia. The distinction between used EEE and wasted equipment is sometimes not clear. It is also exported in white vans to other EU countries.
- Due to the long lifespan of PV panels, they are not yet discarded in large quantities in the Netherlands.
- Material value: Large equipment contains valuable materials, especially metals, which are reclaimed in compliant recycling. There is also a 42 kt of estimated non-compliant recycling. During non-compliant recycling, the base metals and copper are reclaimed. There are several supply routes to metal traders via retailers, curbside collection, and installation companies that exchange old equipment for new equipment. The medium value WEEE (e.g. washing machines) could still be incorporated in mix flows, which are accepted by WEEELABEX-recyclers for treatment. The percentage is believed to be low, but even a percentage of 0.5% results in 5 kt/y. Additionally, the WEEE Flows can still be accepted in mixed 'pre-shredder' flows by non WEEELABEX-recyclers or can still be exported to foreign recyclers, most likely in Belgium or Germany.

FIGURE 23. SCENARIO: SMALL EQUIPMENT



Scenario 5: Small equipment



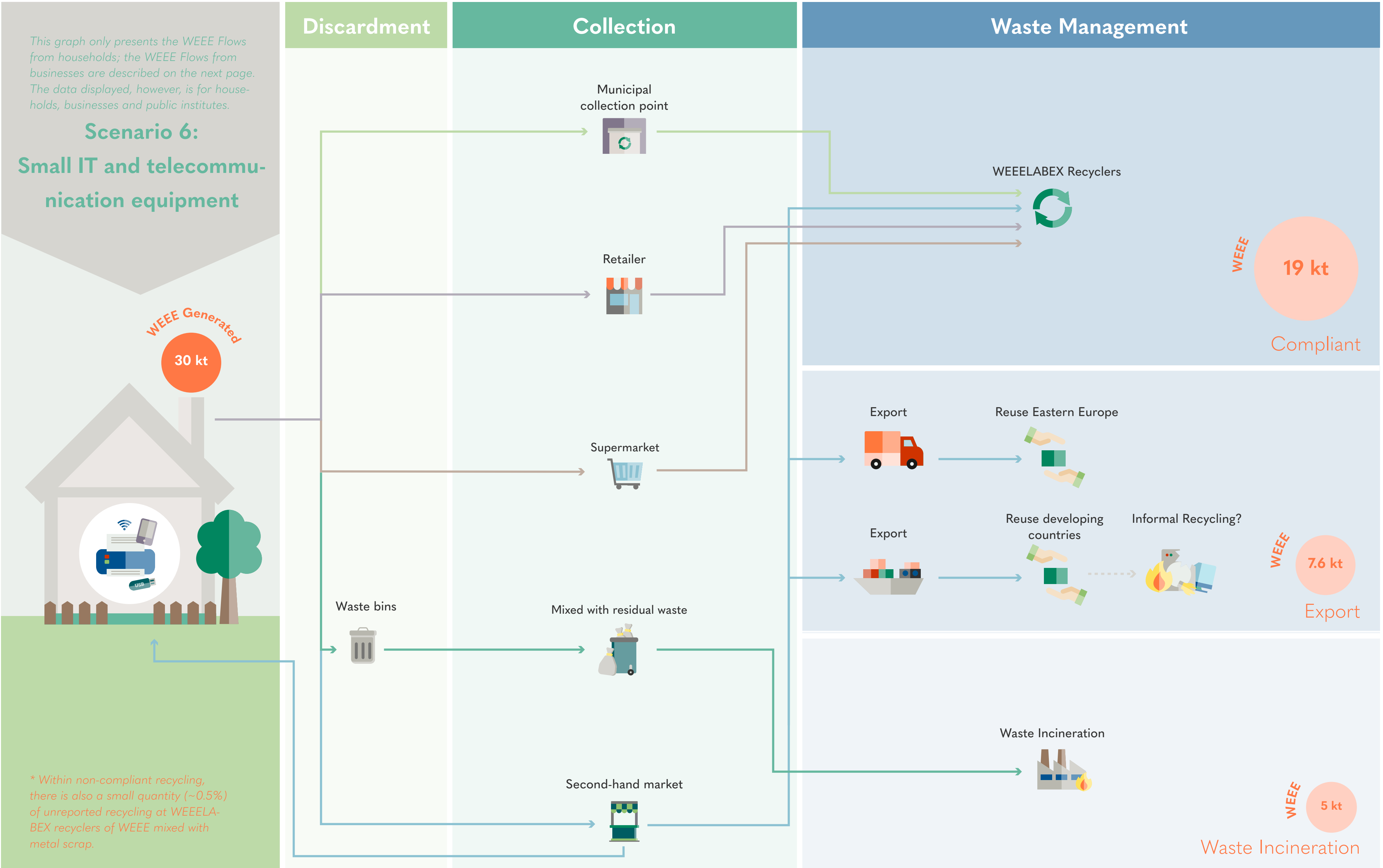
In 2018, a total of 126 kt of small equipment was placed on the market. Adequately understanding the EEE POM of small equipment was rather difficult. Based on the common methodology, the EEE POM of small equipment was 152 kt, while the NWR only registered 99 kt. It is clear that household luminaires are not registered in the NWR, but were included in the common methodology. However, this does not explain the difference. Therefore, it is suspected that free-riding might be happening in the NWR, and/or the common methodology overestimates the EEE POM. The total WEEE Generated of small equipment was 108 kt in 2018. The small equipment contains household products such as small kitchen appliances, appliances for personal care, household luminaires, and small tools, as well as professional appliances such as professional luminaires and small medical equipment.

The small equipment was managed by compliant recyclers (44 kt), exported for reuse (4.6 kt), incinerated (25 kt), and/or managed by non-compliant recyclers (31 kt). The non-compliantly recycled WEEE can also include export flows to foreign recyclers, most likely in Belgium or Germany.

Small equipment has the following characteristics that impact the collection and management of the waste:

- Size: Since small equipment easily fits into waste bins, its presence in waste bins is common in the Netherlands. The amount grew slightly from 21 kt in 2010 to 25 kt in 2018.
- Lifetime distribution: Some small equipment is sent to other parts in the world to be reused. This includes small equipment exported in cars and containers to developing countries and small equipment exported in white vans to eastern Europe.
- Value: There is a high amount of non-compliant recycling of small equipment, which is sold by retailers or picked up from the curbside collection by informal recyclers, especially of products with higher metal value. In such cases, it might be recycled together with plastic waste or metal waste, but not all recyclables are reclaimed.

FIGURE 24. SCENARIO: SMALL IT



Scenario 6: Small IT

In 2018, 25 kt of small IT were placed on the market, and 30 kt of small IT were generated. This is more than the quantity of POM. This discrepancy can be explained by miniaturization of small IT POM in relation to the heavier items discarded, as well as by the fact that fewer heavy desktop computers are sold than discarded.

Small IT includes products for households such as mobile phones, GPS and other navigational equipment, pocket calculators, personal computers, printers, and telephones (screens greater than 100cm^2 are in category 2).

The household small IT was collected by municipal collection points, supermarkets, retailers, charities, was refurbished, or was disposed of in waste bins. The small IT waste from businesses was collected by professional collection companies. The small IT waste was managed by compliant recyclers (19 kt), incinerated (5 kt), and exported for reuse (7.6 kt). There are -1.6 kt of undocumented flows, which are probably the result of the uncertainties of the WEEE Flows. There could also be a small quantity of small IT recycled by non-WEEELABEX recyclers.

Small IT has the following characteristics that impact the waste's collection and management:

- Weight and Size: since small IT easily fits into waste bins, its presence in waste bins is common in the Netherlands. The amount declined from 13 kt in 2010 to 5 kt in 2018.
- Lifetime distribution: the lifetime of small IT is often extended via second-hand sales, refurbishment, or exportation to developing countries in cars or containers.

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Annex I.
Conversion table

UNU Keys, 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 (washer-dryers, centrifuges)	4	4a	1	1c
0106	Household Heating & Ventilation (e.g. hoods, ventilators, space heaters)	4	4a	1	1c
0108	Fridges (incl. combifridges)	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

UNU Keys, EU (WEEE Directive) categories, and NWR categories

UNU	Full name	EU-6	EU-6PV	EU-10	NWR
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, multifunctionals, 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 players, e-readers, car navigation)	5	5	4	4c
0403	Musical Instruments, Radio, Hi-Fi (incl. audio sets)	5	5	4	4c
0404	Video (e.g. Video recorders, DVD and Blu-ray players, 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

UNU Keys, EU (WEEE Directive) categorie, and NWR categories

UNU	Full name	EU-6	EU-6PV	EU-10	NWR
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, lawnmowers)	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

Categories in National WEEE Register	Description
1a	Large appliances – cooled household
1b	Large appliances – cooled professional
1c	Large appliances – uncooled household
1d	Large appliances – uncooled professional
2	Small household appliances
3a	IT and telecom equipment – tubes
3b	IT and telecom equipment – flat panels
3c	IT and telecom equipment – other household
3d	IT and telecom equipment – other professional
4a	Consumer equipment – tubes
4b	Consumer equipment – flat panels

Categories in National WEEE Register	Description
4c	Consumer equipment – other
4d	Consumer equipment – solar panels
5a	Lighting equipment – luminaires professional
5b	Lighting equipment – energy saving lamps household
5c	Lighting equipment – energy saving lamps professional
6	Electrical and electronic tools
7	Toys, leisure, and sports equipment
8	Medical equipment
9	Monitoring and control instruments
10a	Automatic dispensers – cooled
10b	Automatic dispensers – uncooled

10 Categories in WEEE Directive	Description
1	Large household appliances
2	Small household appliances
3	IT and telecom equipment
4	Consumer equipment
5	Lighting equipment
6	Electrical and electronic tools
7	Toys, leisure, and sports equipment
8	Medical equipment
9	Monitoring and control instruments
10	Automatic dispensers

6 Categories in WEEE Directive	Description
1	Temperature exchange equipment (TEE)
2	Screens and monitors
3	Lamps
4	Large equipment
5	Small equipment
6	Small IT

Annex II.
Tables EEE POM, WEEE Generated, WEEE Collected

Calculated EEE POM in the years 2010 to 2018 in this study (differs from POM in National WEEE Register)

EEE POM	2010	2011	2012	2013	2014	2015	2016	2017	2018
1. Temperature exchange equipment	69	65	64	64	67	65	66	69	72
2. Screens	38	29	28	23	19	20	21	17	18
3. Lamps	4	5	4	4	4	5	4	4	4
4a. Large equipment (excluding photovoltaics)	136	143	141	143	144	148	164	166	173
4b. Photovoltaics	2	5	18	30	19	27	34	63	96
5. Small equipment	113	117	112	112	109	115	118	124	126
6. Small IT	25	32	33	30	32	31	30	28	25
Total	**387**	**396**	**400**	**406**	**394**	**411**	**437**	**471**	**514**
Total (ex. PV)	*385*	*391*	*382*	*376*	*375*	*384*	*403*	*408*	*418*
Total in National WEEE Register						**342**	**371**	**417**	**495**
Total in National WEEE Register (ex. PV)						*315*	*338*	*354*	*398*

WEEE Generated in the years 2010 to 2018

WEEE Generated	2010	2011	2012	2013	2014	2015	2016	2017	2018
1. Temperature exchange equipment	54	55	56	57	58	59	59	60	61
2. Screens	41	41	40	40	39	37	36	34	33
3. Lamps	4	4	4	4	4	4	4	4	4
4a. Large equipment (excluding photovoltaics)	107	110	113	115	118	120	123	125	129
4b. Photovoltaics	0	0	0	0	0	0	1	1	1
5. Small equipment	92	94	96	98	100	102	104	106	108
6. Small IT	26	26	27	28	29	30	30	30	30
Total*	**324**	**331**	**337**	**343**	**348**	**353**	**357**	**361**	**366**

**some numbers in the graph do not match the total due to rounding.*

WEEE Collected and compliantly recycled

WEEE Collected	2010	2011	2012	2013	2014	2015	2016	2017	2018
1. Temperature exchange equipment	25	25	23	23	25	26	28	29	34
2. Screens	33	31	28	24	27	21	19	17	16
3. Lamps	2	0	0	0	1	2	2	2	2
4a. Large equipment (excluding photovoltaics)	36	35	33	33	36	47	54	61	69
4b. Photovoltaics	0	0	0	0	0	0	0	0	0
5. Small equipment	24	24	22	21	24	30	31	39	44
6. Small IT	7	9	10	9	21	20	20	18	19
*Unknown**			*18*	*19*					
Total**	**127**	**124**	**135**	**129**	**134**	**145**	**155**	**166**	**184**

** mostly small equipment and small IT, but exact allocation could not be determined.*
*** some numbers in the graph do not match the total due to rounding.*

The Dutch WEEE Flows 2020

What happened between 2010 and 2018?

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