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National E-waste Monitor 2025

NORWAY

In partnership with:

STENA RECYCLING

NORSIRK

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National E-waste Monitor 2025

NORWAY

Colophon

This report was prepared through a collaborative effort involving the United Nations Institute for Training and Research, and the Climate and Environment Research Institute NILU.

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The responsibility for the content of this publication lies with the authors.

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Abstract

UNITAR developed this monitor in the framework of the REWARD project (NFR #336617). REWARD is conceived as an integrated information infrastructure focused on systematically identifying reusable and recyclable materials in e-waste products while determining the associated social, environmental, and economic (SEE) dimensions of circularity interventions.

The specific objective with this report is to develop estimates of the Waste Electrical and Electronic Equipment (WEEE) flows in Norway from 2022 to 2050 and to identify possible gaps and inaccuracies of the official country reporting under the WEEE Directive.

The study applied the internationally recognised measurement framework outlined in (Baldé et al. 2015) and in its updated version (Forti et al. 2018) to quantify the mass balance from Electrical and Electronic Equipment (EEE) to WEEE Generated and the fate of WEEE in Norway for 2022. The study also describes an outlook from 2020 to 2050 over two parallel scenarios: the Business as Usual (BaU) and the Circular Economy (CE) scenario. Stakeholders were also consulted as a means for collecting additional inputs and data on the current WEEE statistics and future projections.

The study's main outcomes show that in Norway, the EEE Put On the Market (EEE POM) officially reported by Norway (236 kt) is higher than the one obtained with the apparent consumption method applied in this study (212 kt). This discrepancy may be due to the inclusion of packaging in the official EEE POM statistics. In fact, when the weight of packaging is subtracted from the official statistics, the EEE POM value (205 kt) is in line with the one obtained in this report. Moreover, with 27.5 kg/capita of WEEE in 2022, 32% higher than in 2010, Norway is the biggest producer of WEEE in the world per capita, with small equipment (48 kt) and large equipment (42 kt) being the primary items being discarded. Also in 2022, Norway reached a collection rate of 72% (using the WEEE Generated method), which is below the target of 85% set by the WEEE Directive, but higher than the EU average of 55%.

For future projection scenarios, Norway may devise policies to promote repair, shared ownership, and less hoarding to lower consumption. In this case, the EEE POM may decrease to 67 kt in 2050 as compared to 294 kt in a BaU scenario. The WEEE Generated is projected to show a rather delayed response under CE transition, starting to decrease in 2040 and reaching 142 kt in 2050, while under BaU was estimated to be 255 kt.

List of abbreviations

ABBREVIATIONS	
BaU	Business as Usual
BC	Basel Convention
CE	Circular Economy
EEA	European Economic Area
EEE	Electrical and Electronic Equipment
EC	European Commission
EPR	Extended Producer Responsibility
EU	European Union
HS	Harmonised System
Kg	Kilograms
kt	Kilotons
OECD	Organisation for Economic Co-operation and Development
PIC	Prior Informed Consent
POM	Placed on the Market
PRO	Producer Responsibility Organisation
PV	Photovoltaic
SEE	Social, environmental, economic
t	Tons
UNITAR	United Nations Institute for Training and Research
UK	United Kingdom
WEEE	Waste Electrical and Electronic Equipment

Chapter 1.
Introduction

Electrical and Electronic Equipment (EEE) refers to all products that have circuitry or electrical components and a power or battery supply (StEP Initiative, 2014). EEE encompasses a wide range of products used by households and businesses, including refrigerators, stoves, washing machines, and hairdryers, as well as electronic devices such as mobile phones, wireless headphones, and tablets. High-income countries average 109 EEE items per capita, while low-income countries can average as few as 4 items per capita (Baldé et al. 2024).

EEE becomes e-waste, or Waste Electrical and Electronic Equipment (WEEE), once it is discarded by its owner with no intention of reusing the item (StEP Initiative, 2014). In this study, the authors decided to predominantly use the term WEEE as opposed to e-waste, which is in step with the main EU terminology. The classification of WEEE is illustrated in the next section.

Even though EEE is an essential part of everyday life, the way in which we produce, consume, and dispose of WEEE is not sustainable. Because of slow rates of WEEE collection and recycling, externalities such as the consumption of resources, the emission of greenhouse gases, and the release of toxic substances during informal recycling procedures are not sustainable in the long run. Even countries with a formal e-waste management system in place generally have relatively low collection and recycling rates. In 2022, a record 62 kt of WEEE was generated globally (an average of 7.8 kg per capita per year); 22.3 percent of this e-waste mass was documented as formally collected and recycled in an environmentally sound manner. Since 2010, the growth of WEEE generation is outpacing formal collection and recycling (Baldé et al. 2024). However, there are differences both at the regional level and by level of income. For instance, in Europe, 17.6 kg/capita were generated in 2022, with a collection rate of nearly 43%, while in the African continent, 2.5 kg/capita of WEEE were generated the same year, with a formal collection and recycling rate of less than 1%.

Monitoring WEEE quantities and flows is a key to understanding developments over time and to setting and assessing targets toward a sustainable society and Circular Economy. In Europe, Article 16 of the main regional legislation regulating WEEE, the WEEE Directive, requests all Member States "to collect information, including substantiated estimates, on an annual basis, on the quantities and categories of EEE placed on their markets, collected through all routes, prepared for re-use, recycled and recovered within the Member State, and on separately collected WEEE exported, by weight" (Directive 2012/19/EU). The WEEE Directive also sets targets on WEEE collection, which, however, are not currently being reached by all Member States (Baldé et al. 2022).

Norway introduced WEEE regulation in 1998 and initiated the WEEE recovery system in 1999 (Ylä-Mella et al., 2014). Norway is required to implement EU Directives in its national legislation by the EEA (European Economic Area) agreement (EFTA 2018); in June 2006, the Norwegian WEEE legislation (Chapter 1 of the Waste Regulation) was revised to comply with the WEEE Directive. Also in 2006, an administrative national EEE register (EE-registeret), owned by the Norwegian Environment Agency (Miljødirektoratet), was established to provide an overview of all EEE and WEEE imports and exports from all producers and importers. Furthermore, the recast WEEE Directive 2012/19/EU entered into force on 13th August 2012 and had to be transposed into national law by 14 February 2014. In line with that directive, Norway has implemented a new scope and relevant categories, which include the 6 categories under the EU scope plus two additional categories (see further details in the methodological section: 2.1 Classification).

Two recent national studies outlined the picture of WEEE flows in Norway, also in relation to the main trends in Europe. The first report maps out the main potential sources of error contributing to the discrepancy between EEE Placed on the Market (POM) and WEEE collected, while the second report provides the latest data on WEEE flows and puts forward suggestions for a reconfiguration of responsibilities along the value chain (Gylling et al. 2018, Baxter et al. 2021).

Gylling et al. (2018) also highlighted some limitations/uncertainties in the calculation performed, including in the EEE POM, stock, and complementary WEEE flows. Baxer et al. (2021) highlighted that the “trends in Norwegian data, and particularly the gap between the EEE POM (or waste generated) and the WEEE collected, can be related to the data themselves and the value chains from which the data emerged”. This study strove to identify potential inaccuracies in existing data and pathways to reducing such inaccuracies, thus improving the country performance in relation to the WEEE Directive’s requirements (Baxter et al. 2021).

The study presented herein is part of the REWARD project, begun in 2023 and continuing through 2027. REWARD is conceived as an integrated information infrastructure focused on systematically identifying reusable and recyclable materials in e-waste products while determining the associated social, environmental, and economic (SEE) dimensions of circularity interventions. In REWARD, the data on e-waste generation and e-waste resources, along with SEE parameters, will be fed to the integrated information infrastructure to facilitate automated data sharing and identify optimal e-waste resources recycling options among e-waste actors.[1]

In the REWARD project’s framework, UNITAR developed this monitor with the specific objective of developing estimates of the WEEE flows in Norway from 2022 to 2050 in order to identify possible gaps and inaccuracies of the official country reporting for the WEEE Directive. The study applied the internationally recognised measurement framework outlined by Baldé et al. (2015) and updated by Forti et al. (2018) to quantify the mass balance from EEE to WEEE Generated and the fate of WEEE in Norway for 2022. The study also describes an outlook from 2020 to 2050 over two parallel scenarios, the Business as Usual (BaU) scenario and the Circular Economy (CE) scenario. As well, stakeholders were consulted to collect additional inputs and data on current WEEE statistics and future projections.

The report is structured as follows: following this Introduction (Chapter 1), the classification system and methodological framework are outlined in Chapter 2. Chapter 3 provides an overview of the Norwegian WEEE management system in 2022, and projections out to 2050 are described in Chapter 4 for the BaU and CE scenarios. The study ends with a Summary and a set of Recommendations targeting the national authorities in charge of the WEEE management systems.

The Annex includes details on the WEEE classification system and relevant correlation tables as well as the full UNITAR datasets used for this study.

Chapter 2.
Methodology

2.1 CLASSIFICATION

Given the many types of EEE products on the market, they need to be grouped into sensible, useful categories so that reliable statistics can be produced. The UNU-KEYs, categories in the EU WEEE Directive, and the Norwegian categories are used in this study, as explained below:

- The UNU-KEYS are a product categorisation comprised of 54 categories; developed by UNU (Baldé et al. 2015, Forti et al. 2018), they are used in the Implementing Act to describe the common methodology to calculate the WEEE collection targets for article 7 of the WEEE Directive.[2] The UNU-KEYS are constructed in such a way that product groups share comparable average weights, material compositions, end-of-life characteristics, and hazardous profile and lifetime distributions. The UNU-KEYS encompass all possible EEE (more than 900 products), and their classifications can be linked to the EU categories. Calculations in this study have been performed for 54 product classifications that correspond to the UNU-KEYs.
- The current 6 EU categories, as listed in Annex III of the WEEE-Directive 2012/19/EC, entered into force in 2018, following the first recast of WEEE Directive 2002/96/EC (before there were 10 categories) and are linked to the UNU-KEYS classification system. The data in this study is presented according to the WEEE Directive's six categories. Large equipment is split into two categories, though: one excluding photovoltaics and one including photovoltaics (respectively 4a and 4b).

  The Norwegian national classification system was also updated, after the Directive was recast, to be more aligned with the European system (Gylling et al. 2018). Norway's scope is wider than the WEEE Directive, as some of the exclusions under paragraph 4 in the Directive are not part of the Norwegian context.[3] Categories 7 (large industrial equipment) and 8 (large industrial cables) were introduced in 2018 in Norway's reporting[4] (see Table 1).

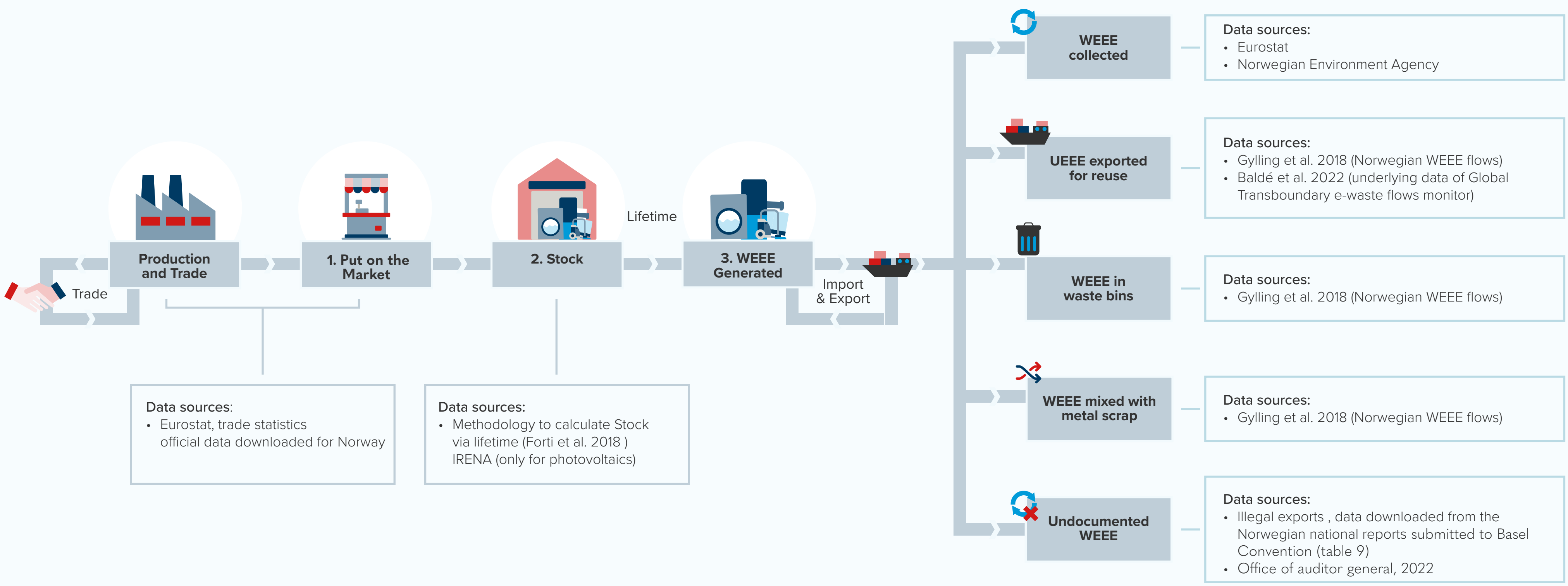
Table 1. Norwegian categorisation of WEEE

NEW CATEGORIES		
1. Temperature exchange equipment	NEW **EU REPORTING** SCOPE AND CATEGORIES	NEW **NORWEGIAN** SCOPE AND CATEGORIES
2. Screens, monitors and equipment containing screens having a surface greater than 100 cm^2		
3. Lamps		
4. Large equipment > 50 cm		
5. Small equipment < 50 cm		
6. Small IT and telecommunication equipment < 50 cm		
7. Large industrial equipment		
8. Large industrial cables		

2.2 MEASUREMENT FRAMEWORK

The measurement framework of the WEEE projections follows a mass balance approach over EEE's entire life cycle. This approach is consistent with the global e-waste statistics guidelines (Baldé et al. 2015; Forti et al. 2018). It is based on flows and stocks of EEE and WEEE. The model is constructed in such a way that the stocks and flows are mathematically interrelated. The approach covers production, imports, placing on the market, WEEE generation, WEEE management, and other WEEE-related activities. It covers any product supplied to the national market for consumption that is used by households, businesses, or public authorities.

Figure 1. Measurement framework



The measurement framework follows four steps (Figure 1): first, tracking of the production and trade of EEE to calculate the EEE POM, preferably data, are included over a relatively lengthy time frame. In this study, the EEE POM is calculated from the apparent consumption methodology and is extrapolated from Norway's official reporting to the EC. The apparent consumption methodology is shown in Eq. 1 below:

Eq. 1: Apparent consumption method: POM (t) = Domestic production (t) + Imports (t) - Exports (t)

The POM in a historical year t equals the sum of domestic production and imports of EEE in the year t minus the EEE exported in the same year. As well, the official data on the EEE POM reported by Norway to the European Commission is downloaded from the Eurostat website and compared to the outcomes of the apparent consumption methodology. Usually, the apparent consumption method is used to make estimates of the POM's weight when there is no available data from countries on product sales in a historical year.

As a second step, after EEE is placed on the market, it stays in households or business for a while until it is discarded - this is referred to as the product's lifetime. The amount of equipment in households, businesses, and the public sector is referred to as the stock. Also, if the product is exported, its lifetime in the origin country is considered to be terminated; third, after a certain lifetime[5], which varies according to the products, the good is disposed of and become waste, which corresponds to the WEEE Generated, prior to collection; and then lastly, the WEEE Generated follows different flows, including the formal and compliant collection. These flows can get lost and be mixed in with either municipal solid waste or metal scraps; they can be exported within the EU or to OECD countries for reuse (in which case they are used EEE as opposed to WEEE), following the relevant international regulations, or they can be illicitly exported. The flows that are unable to be mapped are attributed to the gap and are referred to as the undocumented flows.

Additional details on the mathematical equations used in the methodology are available in Forti et al. (2018, pp. 25-26).

The estimates of WEEE in waste bins and mixed in with metal scrap are also part of the mass balance equation and cross-country comparison. As detailed in (Forti et al. 2018), these estimates are typically obtained through statistical modelling that combines national and regional waste generation data, obtained through the Apparent Consumption Method, with past project outcomes[6] and updated national studies obtained through literature review. These national studies might also include on-the-ground sampling and weight measurement of collected e-waste and complementary streams.

Additionally, exported used EEE flows were estimated based on the methodology developed by Baldé et al. (2022b), which distinguishes between controlled movements (of WEEE) and uncontrolled transboundary movements (of used EEE and WEEE).

The controlled movements of WEEE are quantified (Baldé et al. 2022b), based on the statistics reported by countries to the Basel Convention Secretariat and related to the Prior Informed Consent (PIC) procedure. This method, however, was not included in this study; in fact, since 2022, the Comtrade dataset has introduced a specific HS code (HS 8549) for the WEEE stream. In this study, data reported by Norway under this code was considered for 2022 and 2023 as legal exports or controlled movements. The uncontrolled movements were quantified through a price analysis; where the prices for EEE commodities recorded in the trade statistics were not in line with prices of new EEE but, rather, were considered as used EEE or e-waste (Baldé et al. 2022b).

The estimate of used EEE in the range of 2-4% of the EEE POM (Gylling et al. 2018) was also considered. With all the limitations related to the price analysis as highlighted in Baldé et al. (2022b), like records of low quality or misuse of measures unit by data providers (kg instead of tons), and since the estimates were in line with the range of 2-4% suggested in (Gylling et al. 2018), the approach of (Baldé et al. 2022b) was considered more reliable and is used for this study to estimate the amount of uncontrolled movements.

The amounts of illegally exported WEEE can be hard to separate / discern from other flows. In this study, we analysed the cases of seized WEEE reported by Norwegian authorities to the Basel Convention Secretariat and declared as illegal, for different reasons (the cases are reported to the Basel Convention Secretariat, under Table 9 - for the years 2017-2022).[7] Data in the analysed reports is usually expressed in tons or kilograms; however, in 2021, WEEE seizures were expressed in number of containers, and in 2022, they were expressed in number of WEEE items, without specifying item types. To obtain an estimate, we considered the average weight of a loaded 40-foot container to be approximately 25 tons for 2021 (i Containers, 2024). For 2022, we calculated the average weight of one WEEE item, based on the single weights of the 54 products considered in the UNU-KEYs (Forti et al. 2018, Annex 3). As well, the information included in the latest report by Norwegian office of auditor general was also integrated.

2.3 OUTLOOK TO 2050

In order to develop WEEE projections out to 2050 for Norway, the framework described in section 2.2 has been used, as split into two contrasting scenarios: the Business as Usual scenario (BaU) and the Circular Economy scenario (CE).

EEE POM from 2010 to 2022 was obtained from the apparent consumption method outcomes per UNU-KEY. Only the historic solar photovoltaic installation figures were taken from a global dataset compiled by the International Renewable Energy Agency (IRENA). The POM data has been broken down into the 54 product groups - the UNU-KEYs. The POM data is projected into the future with an empirical relation between EEE POM and country-level scenarios for purchasing power parity Gross Domestic Product per capita, established from the global historic EEE POM and GDP data at the country level from the Global E-waste Monitor dataset (Forti et al. 2020). This study uses GDP PPP and population scenario projections from the Shared Socioeconomic Pathways (SSPs), which represent a plausible range of regional and global socioeconomic futures with various degrees of cooperation, competition, urbanisation, education, technological development, and other relevant indicators (Riahi et al. 2017). The two scenarios, Business as Usual (BaU) and Circular Economy (CE), are described below.

In the BaU Scenario, present-day consumption patterns for EEE goods are projected from 2023 to 2050 with some adjustments according to the underlying economic conditions, population, consumer behaviour, product lifespans, and WEEE management infrastructure. We factored in only full obsolescence of EEE POM for products that are phased out from the market. In the CE scenario, additional behavioural and/or technological changes are assumed to occur between 2023 and 2050 for selected product groups (UNU-KEYs), capturing the main aspects of Circular Economy transitions specific to the EEE sector. The overview of the choices is shown in Annex 1. These changes (with illustrations for selected UNU-KEYs) include:

1. The full or partial obsolescence of the selected EEE POM by 2050: e.g., almost a complete drop of some video equipment, due to advances in smartphones and streaming services)
2. Stock saturation constraints per capita: e.g., even if Norwegian households' economic situation improves, it does not make sense to have more than a certain number of items such as fridges or washing machines, which creates market saturation in a wealthy economy such as Norway for certain products
3. Improved durability: also, as result of new regulations (e.g., Ecodesign[8] and Right to Repair Directives[9]), a gradual increase in both designed and user-driven lifespan (reuse) is expected across most EEE products
4. Less hoarding: items such as laptops or mobile phones are expected to be used for longer periods or recycled as opposed to being hoarded, leading to reduced overall stock
5. More sharing: products such as household tools are expected to be shared more, resulting in longer utilisation and reduction in lifespan, as well as reduced overall stock across households

The WEEE Generated is calculated using the EEE POM and lifespan projections for both the BaU and CE scenarios. The WEEE recycling rate is calculated by dividing "WEEE managed environmentally soundly" by "WEEE Generated".

In the CE scenario, an S curve shape was adopted up to a rate of 85%. In cases where the last available year has a collection rate higher than 95%, the remaining years are set to 95%. As with the BaU scenario, the complementary flows were adjusted proportionally in relation to the development of the WEEE collected rates using the average of the last three historical years.

Chapter 3.
Norwegian WEEE management in 2022

3.1 WEEE LEGISLATION

As part of the European Economic Area (EEA), Norway follows the EU WEEE Directive, which sets binding collection and recycling targets for electronic waste across Member States. The Directive's key goal is to ensure that a certain percentage of e-waste, relative to the total amount of EEE sold in the country, is collected and processed.

Regarding the collection target, the WEEE Directive mandates that Member States must collect at least 65% of the average weight of EEE POM in the previous three years or 85% of the total e-waste generated. This means that Norway, like other EU/EEA countries, must meet these targets by establishing efficient collection systems.

Norway also implements the WEEE Directive through its national legislation, specifically the Norwegian Waste Regulation ("Avfallsforskriften"). This regulation outlines detailed responsibilities for producers, importers, and waste management companies and provides a legal framework for setting national e-waste collection targets. Under the waste regulation, producers and importers of electronic goods are responsible for financing the collection and recycling of e-waste. This is known as Extended Producer Responsibility (EPR). They must join approved producer responsibility organisations (PROs) or establish their own systems to ensure that their products are properly collected and treated.

As such, producers are required to report the quantity of electronic equipment they place on the market. Products manufactured domestically are reported by the producers to PROs, while data on imported products are collected from a Customs database. This data, in combination, is used to calculate collection targets. The performance of the collection systems is regularly monitored by environmental authorities to ensure compliance. Norway sets its collection and recycling targets based on both the weight of electronic equipment sold and the amount of e-waste collected annually. These targets focus mainly on two areas: 1) Collection Rate to collect a high percentage of e-waste generated. The national goal is typically aligned with or exceeds the EU requirement of 65-85%. For example, collection obligation identical to EU WEEE directive (cat 1 and 4: 85% collected, of which 70% is reused or recycled; cat 2: 80% collected, of which 70% is reused or recycled; cat 5 and 6: 75% collected, of which 55% is reused or recycled; cat 3: 80% of collected must be recycled), and 2) recycling and Recovery Rates that are specific targets for the recycling and recovery of materials from e-waste.

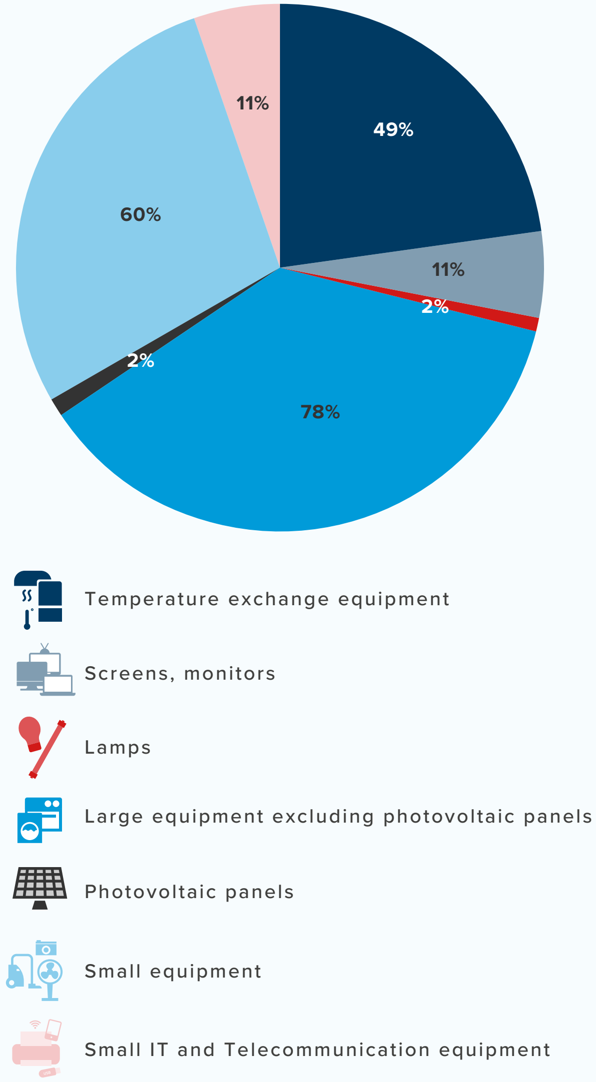
It should be noted that Norway's producer responsibility organisations (PROs), such as Norsirk[10], European Recycling Platform[11], Recipo, and RENAS[12] are essential for meeting collection targets. These organisations coordinate the logistics of collecting e-waste from municipal recycling centers, retail stores, and businesses. They also oversee the proper recycling and disposal of collected waste, ensuring that the materials meet the national recycling and recovery goals. Retailers are legally required to accept e-waste free of charge from consumers and from business operators free of charge when they buy new electronics (the "1:1 principle"). This ensures that consumers have convenient options to dispose of their old devices when purchasing new ones. If producers or PROs fail to meet their collection targets, they may face penalties from Norwegian environmental authorities. This ensures that stakeholders remain committed to achieving the targets (Baxter et al., 2021). Norwegian authorities monitor e-waste collection and recycling through mandatory reporting systems. PROs submit data to the authorities on the amount of e-waste collected twice a year and on the amount of e-waste treated once a year. This data is based on reports from producers, importers, and recyclers; it helps ensure that the country meets its e-waste targets and allows for adjustments if necessary. Furthermore, recycling companies must provide annual reports to the Norwegian Environment Agency (Miljødirektoratet) on their collection and recycling efforts.

3.2 RESULTS OF THE NORWEGIAN WEEE STATISTICS

In Norway, from 2010 to 2022, the EEE POM has increased by 35%, reaching 212 kt (apparent consumption method), with the main category being large equipment (78 kt), followed by small equipment (60 kt) and temperature exchange equipment (49 kt). The EEE POM officially reported by Norway (236 kt)[13] is higher than the one obtained with the apparent consumption method. This may be due to the inclusion of packaging in the official EEE POM statistics: when the weight of packaging is subtracted by the official statistics, the EEE POM value (205 kt) is in line with the apparent consumption method.

Norway's total EEE POM for 2022, calculated in this project with the apparent consumption method, is 212 kt. The three main categories consist of large equipment (78 kt), small equipment (60 kt), and temperature exchange equipment (49 kt). Screens and monitors (11 kt), small IT and telecommunication equipment (11 kt), photovoltaic panels (2 kt), and lamps (2 kt) also exist, though in small quantities (see Figure 2).

Figure 2. EEE POM Norway 2022 (kt) by WEEE category, apparent consumption method



The official Norwegian EEE POM outcome is 236 kt, which is slightly higher than the results of the apparent consumption method.

Baxter et al. (2021) investigated the existing and potential reduction factors most likely affecting the official POM calculations, including the use of incorrect commodity codes for imports, the blend of EEE and non-EEE across existing commodity codes, and the effects of gross/net weight declarations and packaging. One would need to acquire additional data, such as the measurement of number of items in the stock by businesses and households, and make sure that this data models outcomes per UNU-KEY to further refine the mass balance and improve the EEE POM data. The difference might be related to errors in the official calculations of EEE POM, such as incorrect weights of EEE registered for POM, wrong application of correction factors, incorrect commodity codes, and the lack of registration of free riders, as outlined by Gylling et al. (2018). One of their conclusions is that certain product groups are probably more affected than others by accounting for (consumer) packaging: calculations for products in group 6 are probably most affected in relative terms, and those for products in groups 4a and 5 are most affected both in absolute terms (around 20 kt of consumer packaging is POM per annum for products in 4a and 5).

Based on the consumers' packaging data used in Baxter et. al (2021), the gap between the data for Norway could be explained by the fact that packaging is included or excluded in the calculation. In fact, when subtracting the weight of packaging (31 kt) from the total EEE POM (236 kt), the value is more in line with the apparent consumption method calculations (205 kt in official data as compared to 212 kt in the apparent consumption method).

The EEE POM (apparent consumption method) from 2010 showed an increasing upward trend over the entire timeseries. From 2010 to 2022, there was an overall increase of 35% (from 156 kt to 212 kt). The evolution is quite in line with the national register's trend, with the official data showing a decrease between 2014-2015 (from 182 kt to 177 kt) and then increasing again, reaching 236 kt in 2022. One reason for the decrease, based on the inputs collected with the national stakeholders, could be related to the decrease in cathode ray tube (CRT) screens, as Norway "emptied" the market for them and replaced them with liquid crystal display (LCD)/flatscreen displays, whose weight is usually a factor three lower (Forti et al. 2018).

From the apparent consumption method data, we can observe an increase of the EEE POM in 2019 (194 kt) as compared to 2018 (166 kt). Overall, it follows a similar trend over the years, with temperature exchange equipment (cat. 1) and small equipment (cat. 5) largely contributing to the EEE POM increase.

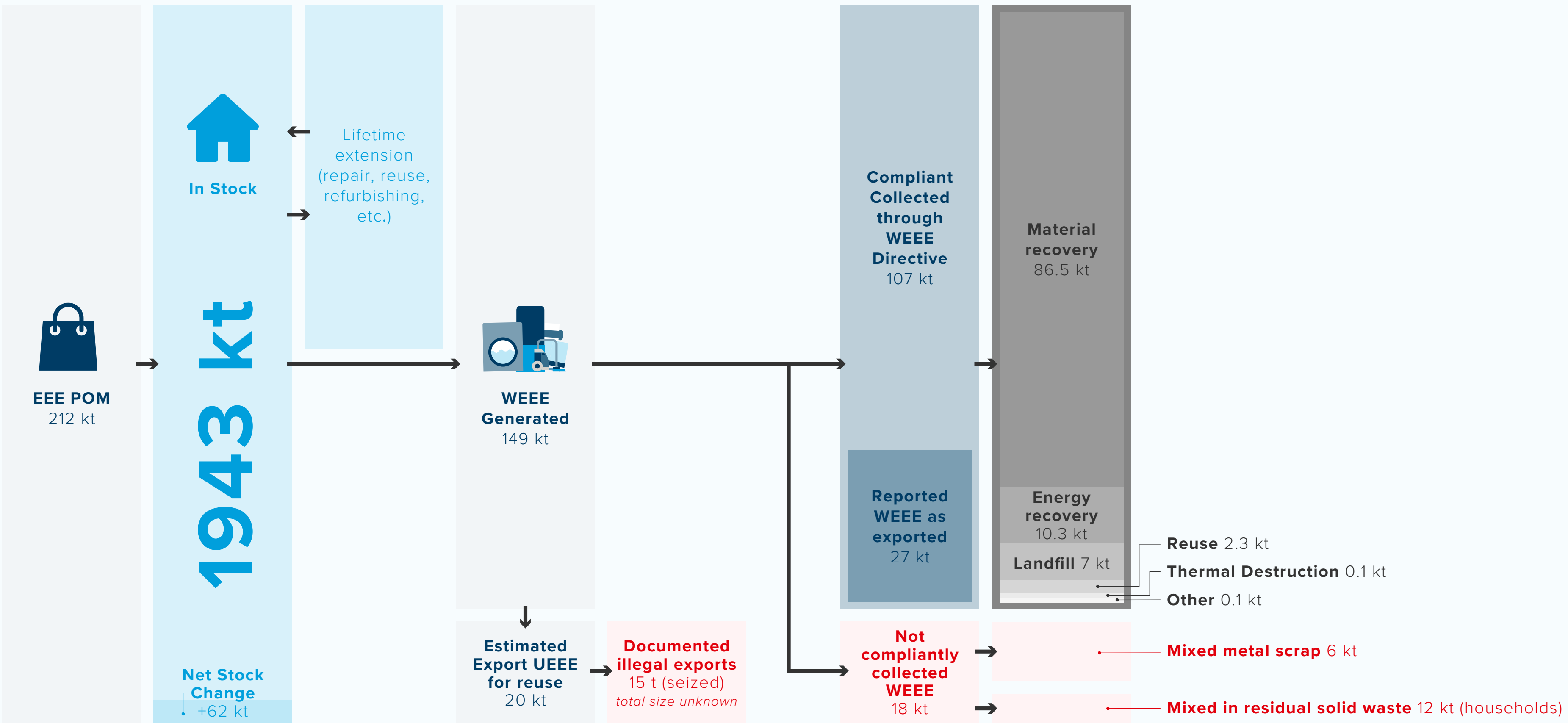
The stock of EEE in Norway, from 2010 to 2022, has slowly increased, going from approximately 14 Mt in 2010 nearly to 20 Mt in 2022, with a stable growth of 2.7% on average, over the twelve years. The EEE stock in 2022 consists of large equipment (34.5%), temperature exchange equipment (27%), small equipment (26.5%), screens and monitors (6.7%), small IT (4%), lamps (0.8%), and photovoltaics (0.5%).

3.3 WEEE FLOWS IN 2022

With 27.5 kg/capita of WEEE in 2022, more than 32% in 2010, Norway is the biggest producer of WEEE per capita in the world, with small equipment (48 kt) and large equipment (42 kt) being the main discarded items. The same year, Norway has reached a collection rate (WEEE Generated method) of 72%, still below the target of 85% set by the WEEE Directive, but higher than the EU average of 55%. The high collection rates have positive effects on the environment and society. In 2022, it was estimated that 42 kt of WEEE (28% of WEEE Generated) are managed outside the formal system or leave the country as used-EEE.

Figure 3 below provides an overview of the WEEE flows in Norway in 2022, highlighting, out of the WEEE Generated in 2022, the amount of WEEE compliantly collected and those either exported as used EEE or staying outside of the formal collection. Details on the single flows are provided in the following paragraphs.

Figure 3. WEEE flows in Norway 2022



WEEE Generated[14]

The WEEE Generated in 2022 was 27.5 kg per capita (149 kt in total) - 70% of the EEE POM for 2022 (see summary Table 2 at the close of this section). This makes Norway the biggest generator of WEEE per capita globally, followed by the UK (Baldé et al. 2024).

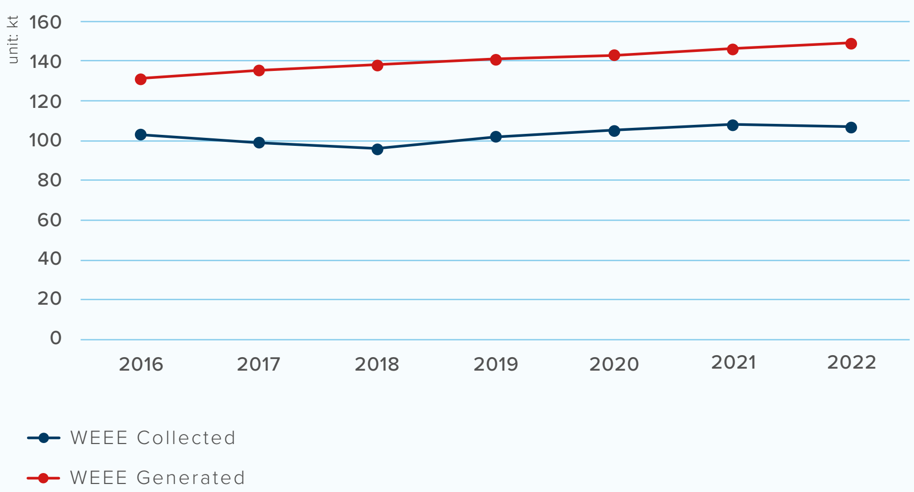
Small equipment represents the largest category of WEEE Generated in terms of weight in Norway, with 48 kt of items such as toys, cameras, e-cigarettes, microwave ovens, etc. discarded during that year. This is in line with global trends, where small equipment represents the first category of WEEE Generated (20.4 kt), followed by large equipment (excluding PV) (15.1 kt) (Baldé et al. 2024).

The second largest category in Norway is large equipment, excluding photovoltaic panels (42 kt), followed by temperature exchange equipment (29.6 kt, almost 20% of the total EEE discarded), screen and monitors (15.5 kt, or 10.4%), and small IT (12.1 kt, or 8.1%).

Photovoltaic panels and lamps are the smallest portions of WEEE Generated (at 0.09 kt and 2.2 kt, respectively).

Small equipment in Norway increased from 31 kt in 2010 to 48 kt in 2022, and large equipment increased from 25 kt in 2010 to 42 kt in 2022. The number of screens and monitors discarded in 2010 and 2022 remained stable (16 kt), despite the general trend being a significant decrease caused by the replacement of relatively heavy cathode ray tube screens with lighter flat-panel displays, as happened, e.g., in the Netherlands (Baldé et al. 2020). Overall, in 2010, Norway generated 101 kt of WEEE (see Annex 2).

Figure 4. WEEE Collected and WEEE Generated, 2016 - 2022 (kt), Norway



WEEE collection and collection rate

As illustrated in Figure 4, Norway experienced a drop in the formal collection of WEEE in 2018 (96 kt) - then started increasing its collection levels, reaching 107 kt in 2022. One interpretation of this trend, based on consultations with Norwegian PROs, could be due to the change in collecting groups in 2018-19 (also see Chapter 3.1). The WEEE categorisation went from 14 groups (plus subcategories) to 8 groups (plus subcategories). Business to business (B2B) products were probably included in the former collection but were not duly reported in the new scenario.

Levels of WEEE collected and WEEE Generated have both increased in parallel since 2018.

Overall, in Europe, the WEEE Directive set two different targets for the WEEE collection, with two respective methods. The EEE POM collection rate is calculated as: WEEE collected (data reported officially in one year)/average EEE POM (on the three preceding years) (see Equation 2) and its target is set at 65% of WEEE collection. The WEEE Generated collection rate is calculated as: WEEE collected (data reported officially in one year)/ WEEE Generated (of the same single year year) (see Equation 3), and its target is set at 85% of WEEE collection.

Eq. 2: Collection rate (EEE POM) = WEEE collected (2022) / average POM (three preceding years - 2019-2021)

Eq. 3: Collection rate (WEEE Generated) = WEEE collected (2022) / WEEE Generated (2022)

Overall, the WEEE collection rate (WEEE Generated) in Norway reached 72% in 2022. This is lower than the defined target of 85% but higher than the average collection rate in the EU (WEEE Generated), which was 55% in 2021 (Baldé et al. 2022). It is also higher than the global collection rate, which is 22.3% (Baldé et al. 2024).

Moreover, the WEEE collection rate reached 57% (POM method using official reported EEE POM data), still not reaching the Norwegian target of 65%[15]. The main reason for this may be related to the national calculation of EEE POM in Norway, which was estimated as higher than the one estimated in this study (236 kt EEE POM reported to the EC, 212 kt estimated in this study). The supposed errors in the POM calculation, which yields a distorted collection rate (POM method), according to the findings of Baxter et al. (2021) and Gylling et al. (2018), can be related to the use of incorrect commodity codes for imports, the blend of EEE and non-EEE across existing commodity codes (i.e., the rationale for the reduction factors that currently exist), and the effect of gross/net weight declarations and packaging.

In Norway, the defined target should comply with one of the two collection rates under the WEEE Directive. Based on a study commissioned by EU PROs, Baldé et al. (2022), four EU countries complied with one of the two targets (the EEE POM method), of which three are EU Member states (Poland, Bulgaria, and Croatia); the fourth is Switzerland. However, some criticism arose around the data provided by those countries, e.g. in Baxter et al. (2021), so the exact number of cases of compliance is not clear. Plus, the WEEE Generated-based target seems more logical than an EEE POM-based target for some countries in the EU, as EEE POM has been shown to increase significantly for new equipment - such as PV panels, e-bikes, and heat pumps - with less or no replacement of old devices. So, WEEE Generated is a preferred metric (Baldé et al. 2022).

WEEE collection by category

In Norway, the largest category of WEEE collected in 2022 is large equipment, in line with the global trends (see Baldé et al. 2024), about 38 kt of large equipment excluding photovoltaics are collected in Norway, out of 39 kt generated. The second and third main categories of WEEE compliantly managed are, in terms of quantity, small equipment (31.4 kt) and temperature exchange equipment (21.4 kt).

However, if we look at their collection rates, large equipment (98%) and temperature exchange equipment (74%) show the highest rates (Figure 5).[16]

Items with a high unit weight have higher collection rates, considering that suppliers are obliged to pick up discarded items when delivering the new products. This is generally true also for screens and monitors, but their collection rate in Norway is one of the lowest one (40%). Based on the consultations with PROs and national authorities, one reason for this might be related to the accumulation of screens in offices, domestic spaces, and households.

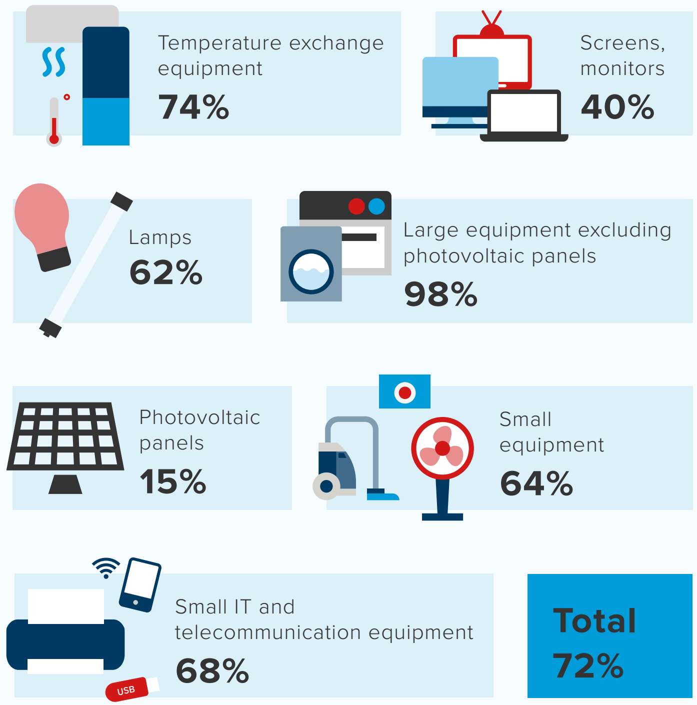
It should be noted that the observed lower collection rate during the pandemic (2020-2021) could reflect the restrictions imposed on retail services during this period.[17]

For smaller items, the responsibility is on consumers, who must return the equipment or drop it off at recycling centres - Norway observes a good general trend both for small equipment (64% duly collected and recycled) and for small IT (68%), which can be related to good levels of awareness of the consumers on collection methods.

Also, the lamp collection rate in Norway (62%) is higher than global trends (5% globally, Baldé et al. 2024) - which is a positive trend, as they contain valuable resources such as rare earth elements, metal, and glass, along with hazardous resources such as mercury.

Overall, small WEEE - including small equipment, small IT, mobile phones, etc. - are among the most challenging WEEE streams to be collected and recycled these days (see e.g., Vermeersch et al. 2024, Ecosweee D2.4). In a study commissioned by the EC on this topic, (Romagnoli et al. 2022) highlighted some of the main challenges that may limit the collection and return rates of small WEEE, including: the household storage, as consumers are reluctant to return their small used EEE and as a result store the equipment at home; discarding it through municipal waste streams; scavenging, incompliant collection activities; and illegal exports of WEEE to less developed countries. The transition to CE and the resulting increase in the usability, repairability, and circulation of such equipment would certainly help decreasing the level of waste generation.

Figure 5. WEEE collection rate by category 2022



Material recovery and recycling rates of official collected WEEE in Norway
Every year, the Norwegian Environmental Agency (Miljødirektoratet) compiles data on the different treatments for each category of WEEE[18]. These treatments include material recovery, energy recovery, landfilling, thermal destruction, reuse, and other treatments. The official data has been adapted to fit the results of the model. Based on the calculations performed in this study (see more details in chapter 2 - Methodology), out of the 107 kt of WEEE compliantly collected, in 2022 the main treatment for collected WEEE was material recovery (81%), followed by energy recovery (10%) and landfilling (7%). Only 2% of the collected WEEE is prepared for reuse (mostly category 6: Small IT and telecommunication equipment and category 2: Screens). Thermal destruction and other treatment comprise less than 1% of the treatment of WEEE.[19]

All targets set by the Norwegian authorities regarding the portions of WEEE collected (see paragraph 3.1) for the various WEEE categories sent to reuse and recycling have been met in 2022.

WEEE outside of the formal management system
In 2022, in Norway, 149 kt of WEEE were generated, out of which 107 kt were documented to be formally collected and recycled. This means that there is a gap of 42 kt of WEEE whose fate is unknown, as it remains outside of the formal management system. In this study, this gap is tracked in four different flows: WEEE in residual solid waste; WEEE mixed in with metal waste; items that are exported as used EEE; and undocumented flows, including illegal exports of WEEE. More details are provided in the below section.

Lost WEEE: WEEE mixed in with residual solid waste and in metal scraps
At the national level, the estimated amount of WEEE that got lost, either mixed in with household waste or mixed in with metals scrap, was 12 kt and 6 kt in 2022, respectively, based on the mass balance methodology applied in this study.[20] This equates to 8% and 4% of the total WEEE Generated.

The same flows in the EU equated, for the WEEE in residual solid waste, to nearly 8% of the total WEEE Generated and, for the WEEE mixed in with metal scrap, to 13.5% (Baldé et al. 2022). While the estimated WEEE mixed in with household waste has the same levels in Norway as the EU on average, the estimated WEEE mixed in with metal scrap in Norway show lower levels - which can be related to better collection methods.

In terms of categories, small equipment represents the totality of WEEE mixed in with metal scrap in Norway and corresponds to 11 out of the 12 kt of WEEE mixed in with residual solid waste. The remaining 1 kt corresponds, instead, to lamps.

WEEE collected in residual solid waste is WEEE discarded in waste bins, either in private households or in businesses/public premises. This largely involves small equipment such as phones, lamps, or batteries. This may be separated and recycled downstream but is most likely incinerated with other residual waste in Norway (Baxter et al. 2021).

WEEE collected with metal scrap may be recycled in a compliant manner, by actors holding the requisite permits, and yet not declared as WEEE neither reported under the WEEE Directive (Baldé et al. 2020). These flows are mainly made of large products, with a high percentage of metal. Some of this flow is handled in large-scale shredders, while other parts are exported for processing.

Used EEE exported for reuse
As explained in the methodological section, exported used EEE flows in this study were estimated based on the methodology developed in (Baldé et al. 2022b), which makes a distinction between controlled movements of WEEE (which are analysed in the next paragraph, Transboundary movements of WEEE), and uncontrolled movements of used EEE and WEEE.

Specifically, the uncontrolled movements (of used EEE and WEEE) were quantified by analysing whether prices of EEE commodities recorded in the trade statistics are in ranges that are more reasonable for used EEE or e-waste than for new EEE (see Baldé et al. 2022b for further methodological details).

In this study, based on the selected methodology, the amount of used EEE in Norway exported for reuse is 20 kt. This is not very far from the assumption by (Gylling et al. 2018) that Norwegian exports of UEEE equate to approximately 2-4% of the EEE POM (it is actually 9% of the EEE POM of 2022, and the estimate would be slightly lower - 5 to 10 kt in 2021 - when EEE POM is officially reported as 236 kt).

The products in this flow do not become waste in the country where the product is placed on the market and are therefore not recorded as WEEE in the country. According to (Baldé et al. 2022b), the main routes of used EEE leaving Northern Europe are directed to West African countries.

According to this study, the main categories of exported UEEE leaving Norway are screens and monitors (10 kt), temperature exchange equipment (6 kt), and small IT (4 kt).

3.4 TRANSBOUNDARY MOVEMENTS OF WEEE

The amount of legally exported WEEE could be around 27 kt in 2022 and 38 kt in 2023[21], equating to 18% of WEEE Generated in 2022 and 26% in 2023, mainly within the EU and UK, which are most likely to recycle specific types of WEEE. 15.5 tons of illegal WEEE exports were seized[22]: the main reasons for illegality include the lack of functionality test, inaccuracy in shipments' documentation (Annex VII), and the lack of consent from the receiving countries.

WEEE exports are legitimate, in principle. WEEE can be exported for recycling purposes, and exporters of WEEE need to ensure that it will be recovered or recycled safely in the receiving country. In some cases, transboundary movements of WEEE or its components are necessary to recover high-value materials (the transportation of waste printed circuit boards to specialised recycling facilities of WEEE from regions where no WEEE management systems exist). Furthermore, transboundary movements of hazardous and other wastes, including WEEE, can pose significant challenges and have an adverse impact on the environment and on human health when not managed properly in countries lacking adequate infrastructure and capacity for managing WEEE in an environmentally sound manner.

Therefore, it is important to put in place rules and procedures for distinguishing between illegal and legal transboundary movements (Baldé et al. 2024).

The main international instrument regulating the transboundary movements of waste, including WEEE, is the Basel Convention, which entered into force in Norway in 1992, following its ratification in 1990. In June 2022, at the fifteenth meeting of the Conference of the Parties to the Basel Convention, amendments to Annexes II, VIII, and IX of the Convention were adopted, mainly aimed at increasing the control of transboundary movements of WEEE and making all electronic and electrical waste, including non-hazardous waste, subject to the Prior Informed Consent (PIC) procedure.[23]

As mentioned, in some cases, WEEE can be exported to other countries, but they must be subject to the PIC procedure - which forms the heart of the Basel Convention control system and is based on four key stages: 1) notification, 2) consent and issuance of movement document, 3) transboundary movement, and 4) confirmation of disposal.

In Europe, the Basel Convention is enforced through the Waste Shipment Regulation n. 1013/2006; the latest revision was adopted by the Council in March 2024.

As of reporting year 2022, WEEE legally exported has been included in the Harmonized Commodity Description and Coding System, also known as the Harmonized System (HS) of tariff nomenclature, an internationally standardised system of names and numbers for classifying traded products, under the HS code 8549 - which specifically refers to “electrical and electronic waste and scrap” (Baldé et al. 2022).

In this study, the controlled transboundary movements of WEEE - corresponding to WEEE legally exported from Norway to other countries - has therefore been quantified based on the data reported by Norway under the HS code 8549, as also detailed in the Methodology.

In 2022-2023[24], Norway legally exported nearly 65 kt of WEEE (27 kt in 2022 and 38 kt in 2023), equating to 18% and 26%, respectively, of the WEEE Generated in each year. The main receiving countries are Sweden (12.8 kt in 2022, 24.3 kt in 2023), the United Kingdom (8.8 kt in 2022, 7.7 kt in 2023), Spain (3.4 kt in 2022, 2.9 in 2023), and Germany (1.7 kt in 2022, 2 kt in 2023). In 2023, only 52 kg were exported outside of Europe and the UK. Apart from these negligible quantities, Norway did not export WEEE for recycling to countries outside the EU and UK in 2022. We can conclude, according to the most recent data by Norway, that the country legally exports WEEE within the EU and UK, most likely to recycle specific types of WEEE.

In terms of imports, Norway imported just 1,600 tons of WEEE in 2022 and 2023, equating to just 1% of the WEEE Generated in both years.

Case of seized illegal WEEE exports

While WEEE can be exported legally, mainly for recycling purposes, illegal exports of WEEE can also take place. Previous analysis, such as (Huisman et al. 2015), highlighted that vulnerabilities exist throughout the entire WEEE supply chain (e.g. collection, consolidation, brokering, transport, and treatment) and that these may lead to offences related to illicit trade, such as inappropriate treatment of WEEE in the receiving countries, violations of WEEE trade regulations, lack of required licenses/permits, smuggling, and false load declarations.

It is particularly challenging to clearly identify legal vs. illegal WEEE shipments, considering the modus operandi of falsely declaring WEEE as used items or even hiding WEEE in legal shipments of UEEE. Illegally exported WEEE are often mixed in with metal scrap, end-of-life vehicles, or other types of waste. Thus, the amounts of illegally exported WEEE can be hard to separate or discern from other flows.

In this study, we analysed the cases of seized WEEE reported by Norwegian authorities to the Basel Convention Secretariat and declared as illegal, for different reasons (the cases are reported to the Basel Convention Secretariat, under Table 9 - for the years 2017-2022).[25]

Data in the analysed reports are usually expressed in tons or kilograms. However, in 2021, the WEEE seizures were expressed in number of containers and in 2022 they were expressed in number of WEEE items, without specifying the types of items. To obtain an estimate, we considered the average weight of a loaded 40-feet container, approximately 25 tons for 2021 (i Containers, 2024). For 2022, we calculated the average weight of 1 WEEE item, based on the single weights of the 54 products considered in the UNU-KEYS (Forti et al. 2018, Annex 3).

This study estimates 15.5 tons of WEEE seized as illicit shipments in 2022. Considering that the authorities can only inspect and detect a small portion of the overall shipments leaving the country, the estimate may be much higher, and seizures usually represent the tip of the iceberg of this waste crime. The latest global estimate is of approximately 2-17 kt of seized illegal WEEE in 2019 out of the 53.6 million tons of WEEE Generated globally (Baldé et al. 2022).

Norway reported to the Basel Convention Secretariat 57 cases of illicit exports of WEEE, or WEEE mixed with in other waste, from 2017-2022. Based on the reported information, the top five destinations for illicit exports are Nigeria, Cameroon, Liberia, Germany, and Ghana.

The declared main reasons for illegality are the lack of functionality testing of the electronic equipment (21 out of 57 cases), lack or inaccuracies of Annex VII[26] (17 out of 57 cases), and lack of consent from the receiving country (14 out of 57 cases).[27] The entity responsible for illegal behaviour is either the exporter or the notifier, and the main measures taken are either the export being denied (31 cases) or the take-back procedure[28] (13 cases). Only 2 cases of WEEE destruction are reported.

Chapter 4. Outlook on WEEE from 2010 to 2050

4.1 OUTLOOK WEEE GENERATION

In a wealthy country such as Norway, the effects of the transition to a Circular Economy could strongly impact the EEE POM. Driven by more repair, less hoarding, and more sharing, all of which decrease consumption, consumption may decrease to 67 kt in 2050 as compared to 294 kt in a BaU scenario. The generation of WEEE is projected to show a rather delayed response to CE transition and only begin decreasing starting in 2040, reaching 142 kt in 2050 as compared to 255 kt in 2050 in the BaU scenario.

This section of the report considers two contrasting scenarios in the EEE sector, both projected to 2050, for long-term WEEE generation and management in Norway: a BaU scenario with current EEE POM and disposal patterns and a CE scenario of improved EEE durability, sharing, reuse, and recycling.

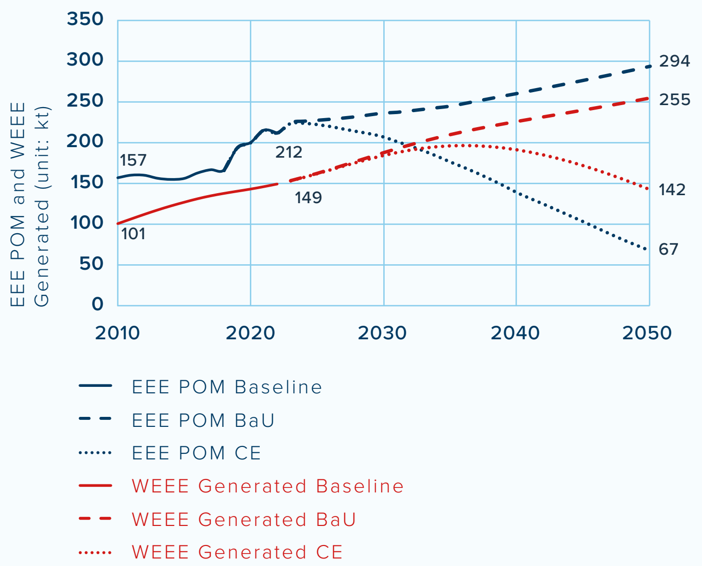
As highlighted in Figure 6, in the BaU scenario, EEE POM is expected to grow - reaching approximately 294 kt in 2050, with an increase of almost 40% as compared to 2022 (212 kt). The CE scenario has a noticeably stronger effect on the POM, as its rate would start decreasing as early as 2026 and would reach 67 kt POM in 2050 - a reduction of 68% from 2022. The CE scenario contrasts significantly with the BaU scenario. The CE model developed in this study, as highlighted in the methodology, incorporates elements such as the stock saturation constraints per capita and increased durability and EEE lifespan, which would bring to more repairability and improved durability of EEE products. A CE scenario is expected to have more sharing and product-service systems, corresponding, for some equipment, to reduced lifetimes - but also to more reuse practice, including the expansion of second-hand markets, and so less hoarding as well. Because of improved legislations and policies toward ecodesign practices, focus will be moved more on the production rather than on the end-of-life phase. Ecodesign also mandates repairability, durability, no planned obsolescence, modularity (products are designed to be easily disassembled, also in terms of batteries), and continual software updates where possible.

In a wealthy, saturated market such as Norway, the effects of a CE transition would be even stronger than, e.g., in developing countries - and this is one reason why the effects on the EEE POM are expected to be so much stronger in the CE scenario than in the BaU scenario.

Figure 6 shows also the resulting projections for WEEE Generated out to 2050. The WEEE Generated shows a more delayed response to the CE transition than in the POM. The WEEE Generated would continue growing, though at a slower pace, until 2035 (196 kt), remain stable for a few years and then begin decreasing in 2039 - reaching 142 kt in 2050. The same figure in the BaU scenario is 255 kt - nearly double. It is expected that the CE effects will be more pronounced in WEEE Generated starting in 2040 if assumed CE trends continue. Included among such trends are: the increase of service-based models for electronics, promoting the use of products as a service rather than ownership, which is expected to reduce WEEE generation; the support and development of circular strategies infrastructure, increasing e.g. access to repairability information or accessibility to spare parts, thus impacting WEEE generation.

There is, however, a level of uncertainty involved. The projections for WEEE Generated depend on several factors, including the EEE POM, the products' lifespans, population, and the GDP. While the latter two are considered stable factors in the calculations, uncertainties on how the POM and lifespan will evolve always need to be considered.

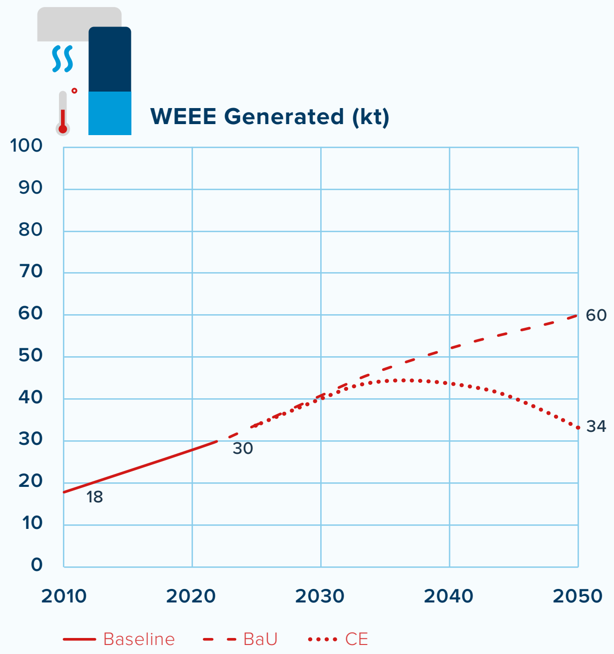
Figure 6. EEE POM / WEEE Generated 2010-2050 (total) BaU-CE scenarios



Overview of WEEE categories

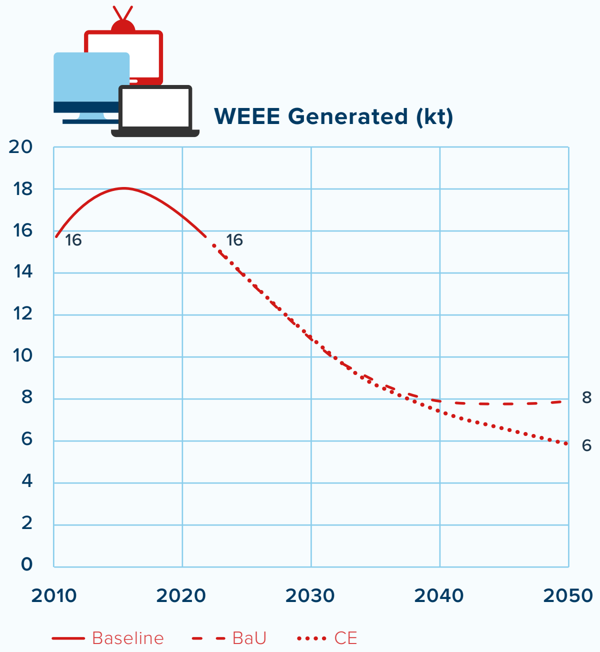
As previously mentioned, the overall trends show that WEEE Generated is following similar growing paths in the CE and BaU scenarios until 2030 and then start decreasing rather drastically in the CE scenario. The development for the underlying categories of WEEE differs, as further outlined below.

Figure 7. Cat. 1 - Temperature exchange equipment WEEE Generated BaU-CE



Temperature exchange equipment follows a path similar to large equipment; in the BaU scenario, it would continue increasing, reaching 60 kt (compared to the 30 kt in 2022), while in the CE scenario, it increase slowly until 2035, reach a tipping point of roughly 44 kt, and then start decreasing, reaching 34 kt in 2050 - which is still a higher quantity than the current waste generation for this category.

Figure 8. Cat. 2 - Screens, monitors WEEE Generated BaU-CE



Screens and monitors show a particular trend - as the amount of WEEE Generated for this category is expected to decrease in both scenarios - though at higher rate in the CE scenario than in the BaU scenario (6 kt in the CE versus 8 kt in the BaU expected in 2050). This could be considered in line with the global trend: this category shows a significant decrease in waste generation by weight (Baldé et al. 2024) caused by the replacement of relatively heavy cathode ray tube screens with lighter flat-panel displays in the waste stream. Flat panel displays' weight is generally one-third that of CRT screens (Forti et al. 2018).

Figure 9. Cat. 3 - Lamps WEEE Generated BaU-CE

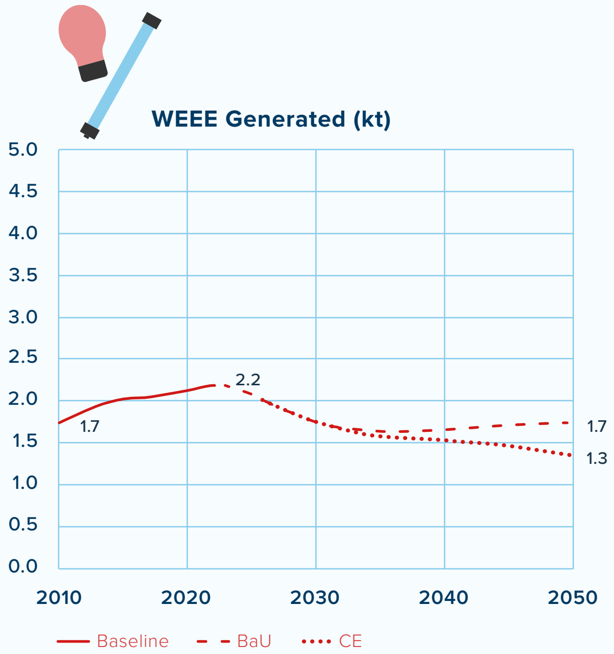
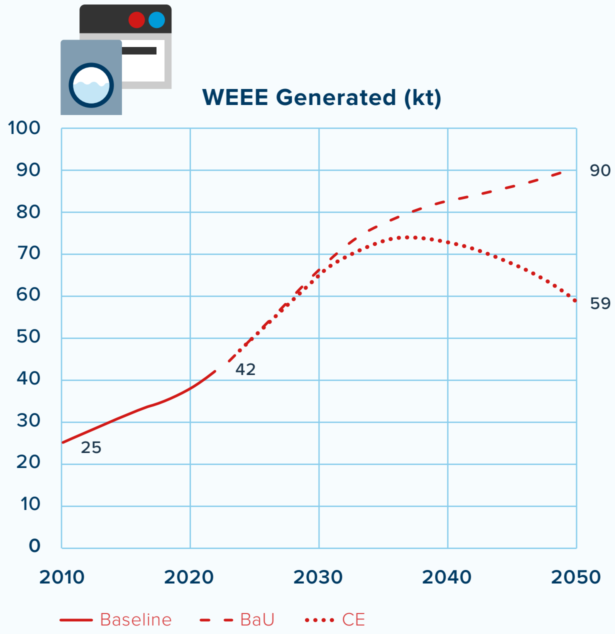


Figure 10. Cat. 4a - Large equipment (excluding photovoltaics) WEEE Generated BaU-CE



Lamps, which generated 2.2 kt of e-waste in 2022, are expected to decrease by 2050 by 0.5 kt in the BaU scenario and 0.9 kt in a CE transition. One reason for these decreases may be related to the latest phase-out policies: as member of the European Economic Area, Norway is required to conform to European regulations to maintain favourable trade status. The country therefore has harmonised with EU No. 2019/2020 and the 2021 Amendments to the RoHS Directive - which includes phasing out compact fluorescent lamps, linear fluorescent lighting, and fluorescent lamps (GLPU, 2022).[29]

Without a CE transition, large equipment (excluding photovoltaics) would continue increasing, reaching 90 kt in 2050 with an increase of 114% over the 2022 generation (42 kt). By contrast, in a CE scenario, the amount generated would increase until 2034, remain stable for about six years, and then begin decreasing, and still reach a higher level than the current one - reaching 59 kt in 2050.

Figure 11. Cat. 4b - Photovoltaics WEEE Generated BaU-CE

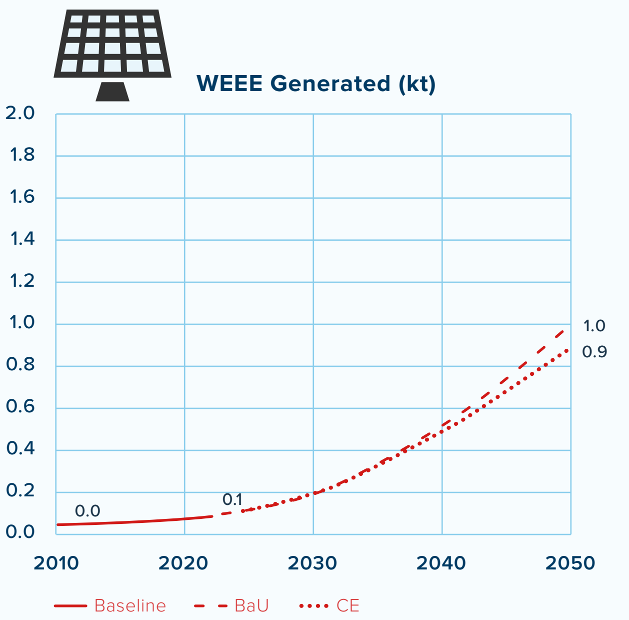
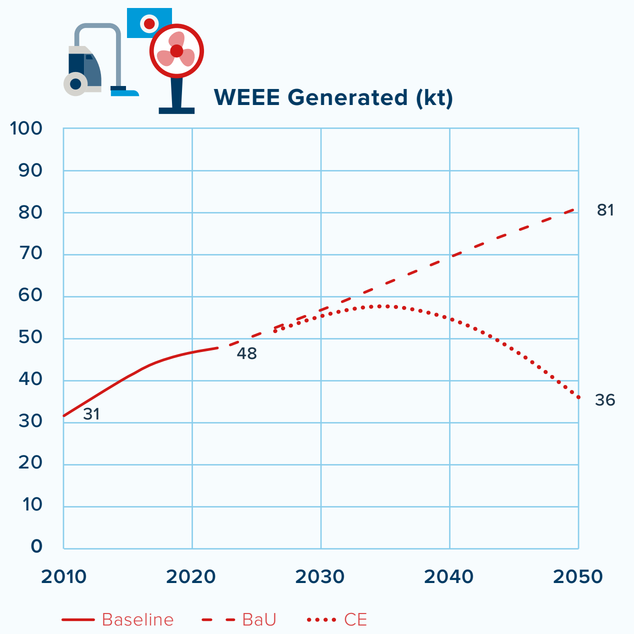


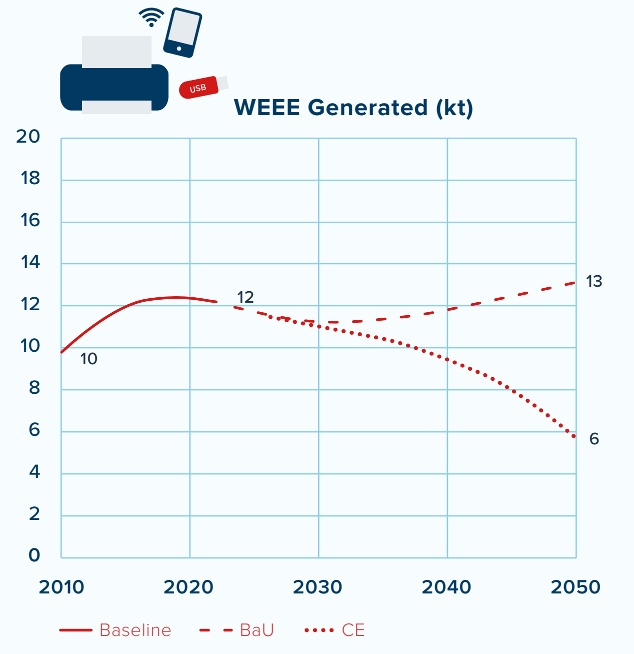
Figure 12. Cat. 5 - Small equipment WEEE Generated BaU-CE



Photovoltaics is the only category of WEEE Generated that is expected to increase in both scenarios. Even though hydropower is the main source of energy for Norway (IEA 2022), previous research has shown that solar energy has potential to become more predominant in Norway (Xue et al., 2021) - so, we can assume some investment in this direction. In the CE scenario, the photovoltaics discarded would jump from 0.1 kt in 2022 to 0.9 kt in 2050. The difference between the two scenarios comes primarily from the modelled lifespan, which is increased in the CE scenario, as explained in the methodological section.

Small equipment - the highest WEEE Generated in 2022 - would begin to benefit from the transition to circular economy starting in 2035. From now until 2035, this type of WEEE is expected to continue growing, albeit more slowly than in the BaU scenario; it would keep a steady level during almost the entire decade 2030-2040 and then start decreasing, reaching 36 kt in 2050 - when it would represent the second largest category of WEEE Generated (see Table 2). The same category in a BaU scenario is estimated as more than double (81 kt) - and would still be the most generated type of WEEE in 2050.

Figure 13. Cat. 6 - Small IT and telecommunication equipment WEEE Generated BaU-CE



Following an initial decrease between 2022 and 2030, when they reach 10 kt, small IT and telecommunication equipment would remain fairly stable in the BaU scenario during the decade 2030-2040. However, they would then increase and reach 13 kt in 2050 - only 1 kt higher than the 2022 levels. The situation is expected to be quite different under the CE scenario, where the level of small IT generated would constantly decrease - and in 2050 would be half of the 2022 amount (6 kt compared to 2022's 12 kt).

Chapter 5.
Summary and recommendations

- The officially reported EEE POM in Norway is 236 kt (Eurostat, 2024). This number is generally higher than the results of the apparent consumption method. This would confirm the assumptions made in previous studies conducted in Norway, that there might be inconsistencies in the official EEE POM calculation as reported under the WEEE Directive. An influencing factor is the inclusion of the weight of EEE packaging in Norway's officially calculated EEE POM. In some cases, these amounts differ quite significantly for some categories (e.g. large equipment's packaging weight is 1.3 kg/capita and small equipment's is 2.8 kg/capita). **The estimated EEE POM from official data in Norway, when subtracted the overall consumers' packaging weight (31 kt, based on Baxter et al. 2021) is about 205 kt -** just 7 kt lower than the estimated EEE POM with the apparent consumption method.
- **This study quantifies 212 kt of EEE POM in Norway in 2022, based on the apparent consumption methodology, with large equipment excluding photovoltaics as the main category (67 kt), followed by temperature exchange equipment (52 kt) and small equipment (51 kt).**
- EEE stock in Norway increased over the period 2010-2022 and nearly reached 20 Mt. If effective CE measures are implemented, it is expected that EEE POM will decrease and reach 2010 levels (14 Mt) by 2050.
- **WEEE Generated was 149 kt in 2022.** This translates to **27.5 kg/capita, which is the world's highest per capita value. The collection rate (WEEE Generated) in Norway in 2022 is 72%,** with a total of WEEE formally collected of 107 kt, approximately 19.5 kg per capita.
- **WEEE in residual municipal waste and metal scrap comprise 8% and 4%, respectively, of the total WEEE Generated** and are almost all related to small equipment. **20 kt of used EEE are estimated to be exported from Norway**, mainly within the EU, for reuse: screens and monitors represent the most exported category. **Undocumented flows represent approximately 2% of the total WEEE Generated** and may include also illegal exports.
- In terms of transboundary movements, based on the analysis of UN Comtrade data, **Norway legally exported 27 kt of WEEE in 2022 and 38 kt in 2023, mainly within EU and UK** and most likely to recycle specific types of WEEE. As well, **15.5 tons of illegal WEEE exports were seized**: the main reasons for illegality include the lack of functionality test, inaccuracy in shipments' documentation (Annex VII), and the lack of consent from the receiving countries.
- In analysing the projections of WEEE management under the Business As Usual and Circular Economy scenarios, **EEE POM 2050 was estimated to be 67 kt in the CE scenario, with a reduction of 68% as compared to BaU in 2022. The big drop is explained by more repairability and improved durability of EEE products**, which has been incorporated in the CE model through, e.g., longer EEE lifespans and constraints in the stock saturation. By contrast, the projection in the BaU scenario would be 5 times higher (294 kt) than in the CE scenario.
- **The WEEE Generated for the time horizon considered shows a more delayed response to the CE transition than the POM does. The items mostly contributing to the WEEE generation drop in the CE scenario would be large equipment, small equipment, and screens and monitors. Photovoltaics are the only items increasing in both scenarios**, though the amounts are projected to be 1 kt in CE and 0.9 kt in BaU in 2050 - which is relatively modest compared to projected global growth of PV panels, which is expected to quadruple globally, from 0.6 kt in 2022 to 2.4 kt in 2030 (Baldé et al. 2024). Currently, PV generation and recycling levels do not represent a significant challenge in Norway, probably due to the fact that Norway already has an almost entirely renewables-based electricity system: in 2020, 98% of generated energy in the country was renewable, with hydropower as the dominant source (92%) (IEA 2022). However, the photovoltaics POM in Norway increased from nearly zero in 2010 (0.036 kt) to almost 2 kt in 2022 - and we can therefore expect an increase in the coming years, as demonstrated in the 2050 projections (3 kt of EEE POM is expected by 2050 in both scenarios).

WEEE Generated was 149 kt in 2022. This translates to 27.5 kg/capita, which is the world's highest per capita value.

Table 2. Summary of WEEE flows in Norway, 2022

2022 (kt)	1. TEMPERATURE EXCHANGE EQUIPMENT	2. SCREENS, MONITORS	3. LAMPS	4A. LARGE EQUIPMENT	4B. PHOTOVOLTAIC PANELS	5. SMALL EQUIPMENT	6. SMALL IT	TOTAL
EEE POM (this study)	49	11	2	78	2	60	11	212
EEE POM (official data)	49	15	1.4	69	0.015	89	13	236
WEEE Generated *	29.6	15.5	2.1	41.8	0.09	47.9	12.1	149
WEEE collected	21.4	6.2	1	38.1	0.011	31	8.3	107
WEEE mixed in with municipal solid waste	0	0	0.6	0	0	11.4	0	12
WEEE mixed in with metal scrap	0	0	0	0	0	5.9	0	6
Used EEE exported for reuse	6	9.5	0	0.8	0	0	3.6	20
TRANSBOUNDARY MOVEMENTS OF WEEE								
Legal exports of WEEE (HS 8549 reporting)	na	na	na	na	na	na	na	27
Seized illegal exports of WEEE (based on data submitted to the Basel Convention Secretariat, which are most likely part of the Undocumented WEEE flows)	na	na	na	na	na	na	na	0.015

* Error margin on WEEE Generated is +/- 10 percent, depending on whether lifespans are 30 percent longer or shorter.

RECOMMENDATIONS

Here we provide some recommendations based on the provided analysis and consultation with project partners to reduce e-waste generation and improve collection and recycling of e-waste.

Monitoring of WEEE flows

- The WEEE monitoring, which is based on the entire lifecycle, from EEE POM to stocks, WEEE generation and a mapping of the WEEE flows, including non-compliant flows and gap analysis per WEEE category is recommended. The WEEE monitoring can be based on the methodology used in this report. Tracing specific material flows along the entire lifecycle from EEE to WEEE is also advisable. This enables a factual basis for improving collection rates and material recovery in Norway.
- Based on the outcomes of the stock and flow model and the benchmark analysis, the weight of the EEE consumers' packaging should be excluded from the EEE POM quantification. This could lead to more accurate predictions of e-waste generation in the coming years, enabling the development of more effective policies for improved e-waste management and helping to decrease the distance to the target objective (65% of EEE POM or 85% of WEEE Generated; WEEE to be collected), as requested by the WEEE directive.
- HS codes are not accurate enough to provide precise information on characterisation of products. A self-assessment by producers and importers, combined with HS codes, could help in better understanding which products are entering the Norwegian market. For example, this could assist in better production and packaging weight estimates.

Circular economy

- Further incentivise, also through targeted policies, the transition to the Circular Economy so that the EEE sector can benefit in terms of products' design, repairability, etc. and also lower the amount of discarded EEE. More specifically:
  - Strengthen extended producer responsibilities, including by the sustainable design of products. This requires manufacturers to design products that are easier to repair, upgrade, and recycle.
  - The use of modular design should be also promoted to help extend product lifespans.
  - The repair and refurbishment industries should be supported through subsidies and tax incentives.
  - Public awareness campaigns should be promoted to encourage consumers to repair (as opposed to replace) electronics.
  - Establish online platforms to facilitate the resale or donation of functional used electronics.
  - Strengthen take-back schemes so that all producers are responsible for collecting and recycling end-of-life electronics.

Recycling of WEEE

- Even though the amount of managed WEEE is currently higher than the amount of unmanaged WEEE, Norway needs to further improve recycling techniques and technologies in order to extract valuable materials and correctly manage hazardous substances.
- Develop and implement targeted measures to increase consumers' and private companies' awareness on how to discard small EEE - which is the most challenging WEEE category to be collected and recycled these days. Some of these measures could involve public campaigns promoting reward incentives for consumers or organising collection days at designated places, such as schools.
- Clear labelling of recyclable components should be required as mandatory, as well as of chemical substances included in the products, to facilitate the recycling process.
- Incentives should be provided for manufacturers to use more recyclable and sustainable materials in the electronic products.
- Invest in advanced recycling technologies to increase recovery rates of valuable materials such as rare earth metals and precious metals.
- Require public institutions to prioritise electronic products that meet eco-design standards and have high recyclability.

Other actions (enforcement, research, etc.)

- Setting more ambitious targets for e-waste reduction, collection, and recycling rates in accordance with the WEEE directive.
- Enforcing penalties for improper disposal of e-waste and illegal exports of WEEE.
- Mandating the use of refurbished or recycled electronics where feasible.
- Funding research and innovation for sustainable materials, recycling technologies, and e-waste tracking systems.

Chapter 6.
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Chapter 7.
Notes

1 https://nilu.com/project/2549785/.

2 The WEEE Directive has recently been revised. The new Directive 2024/884 - as an Amendment of Directive 2012/19/EU on WEEE - entered into force on 8 April 2024 and will need to be transposed by Member States (MS) no later than 9 October 2025. Source: https://eur-lex.europa.eu/eli/dir/2024/884/oj.

3 4(b): large-scale stationary industrial tools I 4(c): large-scale fixed installations, except any equipment not specifically designed and installed as part of the installations I 4(e): non-road mobile machinery made available exclusively for professional use I 4(f): equipment specifically designed solely for the purposes of research and development that is only made available on a business-to-business basis.

4 Before 2019, there were 14 categories of WEEE in Norway.

5 The lifetime profiles of the UNU-KEYs are available in Forti et al. 2018, Annex 2, p. 62.

6 i.e. 'Prospecting Secondary raw materials in the Urban mine and Mining wastes' - ProSUM Project, 'In-depth review of the WEEE Collection Rates and Targets 2020' and the 'Update of WEEE Collection Rates, Targets, Flows, and Hoarding - 2021'.

7 As reported by the Office of auditor general (Riksrevisjonen, 2022), the Norwegian Customs refused exports in at least 45 cases in the period 2020-2022, and the Norwegian Environment Agency took over the follow-up of 8 of these. The 37 cases that the Norwegian Environment Agency did not take over concerned, among other things, presumed illegal export of electric motors, cars that Norwegian Customs suspected were destroyed, and WEEE.

8 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1781&qid=1719580391746.

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10 https://norsirk.no/.

11 https://erp-recycling.org/en-no/about-erp-norway/.

12 https://renas.no/english/.

13 The EEE POM officially reported by Norway corresponds to the scope of the WEEE Directive, which includes the 6 WEEE categories (+1). However, the overall Norwegian scope of EEE POM includes more products, as illustrated in the methodological section, Table 1 - Norway categorisation of WEEE.

14 The value of WEEE Generated may have a +/- 10 percent margin, depending on whether or not all lifespans are 30 percent longer or shorter.

15 The collection target was set at 45% for 2016 and was increased to 65% in 2019.

16 We make reference to the SDGs monitoring framework, which has 3 e-waste indicators: total e-waste generated (unit: kg); e-waste formally collected and managed (unit: kg); and e-waste collection rate, which is calculated by dividing the amount of e-waste formally collected and managed (indicator 2) by the amount of e-waste generated (indicator 1) times 100 percent (Baldé et al. 2024).

17 Another explanation, which is valid not only for screens but for all products, could be that Norway also faces several re-declarations on imports. There are import exceptions, such as music equipment for concerts that are sent to Norway for a limited period and then sent out again. This sort of error could be related to the fact that reports of re-declaration are sent directly to Customs, while the Norwegian Environmental Agency and Statistics Norway (SSB) probably do not update their files. If EEE POM versus collection is hit by this, it would bring the percentage of collection to lower amounts.

18 https://produsentansvar.miljodirektoratet.no/.

19 As reported by consulted stakeholders, due to the reporting demands, this amount could much lower than it really is. The swap and return of items directly to companies is not properly detected in the report of the Environmental Agency. Neither is leasing and reuse of e.g. printers, ICT etc.

20 The estimates of WEEE in waste bins and mixed in with metal scrap are also part of the mass balance equation and cross-country comparison. As detailed in (Forti et al. 2018), these estimates are typically obtained through statistical modelling that combines national and regional waste generation data, obtained through the Apparent Consumption Method, with past project outcomes and updated national studies obtained through literature review. These national studies might include also on-the-ground sampling and weight measurement of collected e-waste and complementary streams.

21 As detailed in the methodological section and below in this paragraph, this data was extracted for Norway on the UN Comtrade database, for the newly introduced HS code 8549 specifically on WEEE.

22 As further explained below, this estimate is based on the analysis of the cases of seized WEEE reported by Norwegian authorities to the Basel Convention Secretariat and declared as illegal, for various reasons. These cases are publicly available through the Basel Convention dataset of national reports: https://www.basel.int/Countries/NationalReporting/NationalReports/BC2021Reports/tabid/9379/Default.aspx.

23 https://www.basel.int/Implementation/Ewaste/EwasteAmendments/Overview/tabid/9266/Default.aspx.

24 Data was extracted in July 2024 for HS code 8549 in the Comtrade database for the years available, 2022 and 2023.

25 As reported by the Office of auditor general (Riksrevisjonen, 2022), the Norwegian Customs refused exports in at least 45 cases from 2020-2022, and the Norwegian Environment Agency took over the follow-up of 8 of these. The 37 cases that the Norwegian Environment Agency did not take over concerned, among other things, presumed illegal export of electric motors, cars that Norwegian Customs suspected were destroyed, and WEEE.

26 According to Article 18 of the Waste Shipment Regulation (N 1013/2006), which enforces the Basel Convention at European Level, waste listed as green needs to be accompanied by the Annex VII document, which contains information related to the waste shipped, the recovery operations, etc. Infringements can be related to inaccuracies in the Annex VII or the complete absence of Annex VII when the shipment starts.

27 Receiving countries must be informed of a transboundary movement of waste through the PIC procedure, and the shipment reception must be duly confirmed.

28 If waste, including WEEE, is illegally exported, the exporter has the obligation of repatriating the shipments at its own costs. If this is not implemented, the shipping country should bear the costs for take-back procedures.

29 https://www.clasp.ngo/wp-content/uploads/2023/04/Lighting-Policy-Bulletin_1_English-1.pdf.

Chapter 8. Annexes

Annex 1. UNU-KEY to WEEE Directive Categories in EU, + Norwegian Categories

Table 3. Parametrisations of the five Circular Economy (CE) consumer behaviour and technology pathways for the EEE sector, formulated separately for each UNU-KEY, and the link of the UNU-KEYs to the e-waste categories

UNU KEY	OBSOLESCENCE POM TARGET RELATIVE	SATURATION STOCK PPI TARGET ABSOLUTE	IMPROVED DURABILITY FLAG	LESS HOARDING FLAG	MORE SHARING FLAG DESCRIPTION OF UNU-KEY	DESCRIPTION OF UNU-KEY	BROAD E-WASTE CATEGORIES
0001	0		X			Central Heating (household-installed)	IV
0002			X			Photovoltaic Panels (incl. inverters)	IVb
0101			X			Professional Heating & Ventilation (excl. cooling equipment)	IVa
0102			X	X		Dishwashers	IVa
0103			X			Kitchen equipment (e.g. large furnaces, ovens, cooking equipment)	IVa
0104		0.4	X		X	Washing Machines (incl. combined dryers)	IVa
0105			X		X	Dryers (washer-dryers, centrifuges)	IVa
0106			X	X		Household Heating & Ventilation (e.g. hoods, ventilators, space heaters)	IVa
0108		0.7	X	X		Fridges (incl. combi-fridges)	I
0109			X	X		Freezers	I
0111			X	X		Air Conditioners (household-installed and portable)	I
0112			X	X		Other Cooling equipment (e.g. dehumidifiers, heat pump dryers)	I
0113			X			Professional Cooling equipment (e.g. large air conditioners, cooling displays)	I
0114			X	X		Microwaves (incl. combined, excl. grills)	V
0201			X	X		Other small household equipment (e.g. small ventilators, irons, clocks, adapters)	V

UNU KEY	OBSOLESCENCE POM TARGET RELATIVE	SATURATION STOCK PPI TARGET ABSOLUTE	IMPROVED DURABILITY FLAG	LESS HOARDING FLAG	MORE SHARING FLAG DESCRIPTION OF UNU-KEY	DESCRIPTION OF UNU-KEY	BROAD E-WASTE CATEGORIES
0202			X	X		Equipment for food preparation (e.g. toasters, grills, food processing units, frying pans)	V
0203			X	X		Small household equipment for hot water preparation (e.g. coffee, tea, water cookers)	V
0204		0.8	X	X		Vacuum Cleaners (excl. professional)	V
0205			X			Personal Care equipment (e.g. toothbrushes, hair dryers, razors)	V
0301			X	X		Small IT equipment (e.g. routers, mice, keyboards, external drives & accessories)	VI
0302	0.1		X			Desktop PCs (excl. monitors, accessories)	VI
0303			X	X	X	Laptops (incl. tablets)	II
0304			X		X	Printers (e.g. scanners, multi-functionals, faxes)	VI
0305	0		X	X		Telecommunication equipment (e.g. [cordless] phones, answering machines)	VI
0306		2	X			Mobile Phones (incl. smartphones, pagers)	VI
0307			X			Professional IT equipment (e.g. servers, routers, data storage, copiers)	IVa
0308	0		X			Cathode Ray Tube Monitors	II
0309			X			Flat-Panel Display Monitors (LCD, LED)	II
0401			X			Small Consumer Electronics (e.g. headphones, remote controls)	V
0402	0		X			Portable Audio & Video (e.g. MP3, e-readers, car navigation)	V
0403	0.25		X			Musical Instruments, Radio, Hi-Fi (incl. audio sets)	V
0404	0.1		X			Video (e.g. Video recorders, DVD, Blu-Ray, set-top boxes) and projectors	V
0405			X	X		Speakers	V
0406	0		X			Cameras (e.g. camcorders, photo and digital still cameras)	V
0407	0		X			Cathode Ray Tube TVs	II

UNU KEY	OBSOLESCENCE POM TARGET RELATIVE	SATURATION STOCK PPI TARGET ABSOLUTE	IMPROVED DURABILITY FLAG	LESS HOARDING FLAG	MORE SHARING FLAG DESCRIPTION OF UNU-KEY	DESCRIPTION OF UNU-KEY	BROAD E-WASTE CATEGORIES
0408			X			Flat-Panel Display TVs (LCD, LED, Plasma)	II
0501			X			Small lighting equipment (excl. LED and incandescent)	V
0502	0		X			Compact Fluorescent Lamps (incl. retrofit and non-retrofit)	III
0503			X			Straight Tube Fluorescent Lamps	III
0504			X			Special Lamps (e.g. professional mercury, high- and low-pressure sodium)	III
0505			X			LED Lamps (incl. retrofit LED lamps)	III
0506			X			Household Luminaires (incl. household incandescent fittings and household LED luminaires)	V
0507			X			Professional Luminaires (offices, public space, industry)	V
0601			X		X	Household Tools (e.g. drills, saws, high-pressure cleaners, lawnmowers)	V
0602			X		X	Professional Tools (e.g. for welding, soldering, milling)	IVa
0701			X	X		Toys (e.g. car racing sets, electric trains, music toys, biking computers, drones)	V
0702			X	X		Game Consoles	VI
0703			X		X	Leisure equipment (e.g. sports equipment, electric bikes, jukeboxes)	IVa
0801			X			Household Medical equipment (e.g. thermometers, blood pressure meters)	V
0802			X			Professional Medical equipment (e.g. hospital, dentist, diagnostics)	IVa
0901			X			Household Monitoring & Control equipment (alarm, heat, smoke, excl. screens)	V
0902			X			Professional Monitoring & Control equipment (e.g. laboratory, control panels)	IVa
1001			X			Non-cooled Dispensers (e.g. for vending, hot drinks, tickets, money)	IVa
1002			X			Cooled Dispensers (e.g. for vending, cold drinks)	I

Annex 2. Datasets

Table 4. EEE POM (apparent consumption method), by category 2010 - 2050

EEE POM (APPARENT CONSUMPTION METHOD) (kt)	2010	2020	2022	2030 BaU	2030 CE	2040 BaU	2040 CE	2050 BaU	2050 CE
1. Temperature exchange equipment	36.9	45.8	49.1	56.7	48.6	62.8	27.6	70.7	13.6
2. Screens, monitors	15.6	9.7	10.6	70.4	67	76	58.8	82.5	40.7
3. Lamps	2.3	2.5	2	1.6	1.6	1.7	1.4	1.8	1
4a. Large equipment (excluding photovoltaics)	38.1	71.9	77.9	85.3	76.5	91.2	59.4	102.7	34.3
4b. Photovoltaics	0.05	0.6	1.9	2.7	2.7	2.4	2.3	3.1	3
5. Small equipment	50.1	58.1	60	71.7	60.8	82	34.4	93.1	9
6. Small IT and telecommunication equipment	13.3	11.4	10.5	11.3	10.3	12.5	7.6	14	2
TOTAL	**156**	**200**	**212**	**237**	**207**	**260**	**139**	**294**	**67**

Table 5. EEE Stock, by category 2010 - 2050

EEE STOCK (kt)	2010	2020	2022	2030 BaU	2030 CE	2040 BaU	2040 CE	2050 BaU	2050 CE
1. Temperature exchange equipment	344	482	523	679	654	801	595	911	395
2. Screens, monitors	196	142	131	86	85	71	62	73	47
3. Lamps	13	15	16	13	13	14	12	15	10
4a. Large equipment (excluding photovoltaics)	412	595	670	905	874	1010	830	1118	630
4b. Photovoltaics	1.8	7.3	1.9	2.7	2.7	2.4	2.3	3.1	3
5. Small equipment	367	488	515	640	608	776	519	897	263
6. Small IT and telecommunication equipment	74	79	76	72	69	77	57	85	29
TOTAL	**1411**	**1810**	**1943**	**2426**	**2335**	**2798**	**2124**	**3167**	**1443**

Table 6. WEEE Generated, by category 2010 - 2050

WEEE GENERATED (kt)	2010	2020	2022	2030 BaU	2030 CE	2040 BaU	2040 CE	2050 BaU	2050 CE
1. Temperature exchange equipment	17.6	27.6	29.6	40.5	39.8	52	44.2	59.5	33.5
2. Screens, monitors	15.7	16.6	15.5	10.9	10.9	7.8	7.3	7.8	5.8
3. Lamps	1.7	2.1	2.1	1.7	1.7	1.6	1.5	1.7	1.3
4a. Large equipment (excluding photovoltaics)	25.1	37.8	41.8	66.1	65	82.4	72.8	90.4	58.8
4b. Photovoltaics	0	0	0	0.2	0.2	0.5	0.5	1	0.9
5. Small equipment	31.2	46.7	48	56.8	55.5	69.5	55	81	36
6. Small IT and telecommunication equipment	9.6	12.2	12	11.2	11	11.8	9.5	13.1	5.6
TOTAL	**101**	**143**	**149**	**187**	**184**	**226**	**191**	**254**	**142**

Table 7. WEEE collected, by category 2010 - 2050

WEEE COLLECTED (kt)	2010	2020	2022	2030 BaU	2030 CE	2040 BaU	2040 CE	2050 BaU	2050 CE
1. Temperature exchange equipment	17.6	19.5	21.4	32.3	32.6	41.5	36.8	47.5	28.2
2. Screens, monitors	15.7	7.6	6.2	4.2	7	3	6	3	5
3. Lamps	1.7	1.2	1	1.2	1.4	1.2	1.2	1.3	1.1
4a. Large equipment (excluding photovoltaics)	25	36	38.1	56.2	61.7	70	69	76.8	55.8
4b. Photovoltaics	0	0	0.011	0	0	0.1	0.2	0.5	0.7
5. Small equipment	31.2	32.5	31.4	35	41.5	42.8	45	50	30.2
6. Small IT and telecommunication equipment	9.6	8	8.3	8	8.5	8.3	7.8	9.2	4.8
TOTAL	**101**	**105**	**107**	**137**	**153**	**167**	**166**	**188**	**126**

Table 8. WEEE mixed in with municipal solid waste, by category 2010 - 2050

WEEE MIXED IN WITH MUNICIPAL SOLID WASTE (kt)	2010	2020	2022	2030 BaU	2030 CE	2040 BaU	2040 CE	2050 BaU	2050 CE
1. Temperature exchange equipment	0	0	0	0	0	0	0	0	0
2. Screens, monitors	0	0	0	0	0	0	0	0	0
3. Lamps	0	0.9	0.5	0.4	0.3	0.4	0.2	0.4	0.2
4a. Large equipment (excluding photovoltaics)	0	0	0	0	0	0	0	0	0
4b. Photovoltaics	0	0	0	0	0	0	0	0	0
5. Small equipment	0	9.1	11.4	13.6	8.7	16.7	6.2	19.5	3.5
6. Small IT and telecommunication equipment	0	0	0	0	0	0	0	0	0
TOTAL	**0**	**10**	**12**	**14**	**9**	**17**	**6**	**20**	**4**

Table 9. WEEE mixed with metal scrap, by category 2010 - 2050

WEEE MIXED IN WITH METAL SCRAP (kt)	2010	2020	2022	2030 BaU	2030 CE	2040 BaU	2040 CE	2050 BaU	2050 CE
1. Temperature exchange equipment	0	0	0	0	0	0	0	0	0
2. Screens, monitors	0	0	0	0	0	0	0	0	0
3. Lamps	0	0	0	0	0	0	0	0	0
4a. Large equipment (excluding photovoltaics)	0	0	0	0	0	0	0	0	0
4b. Photovoltaics	0	0	0	0	0	0	0	0	0
5. Small equipment	0	4	6	7	4	8	3	10	2
6. Small IT and telecommunication equipment	0	0	0	0	0	0	0	0	0
TOTAL	**0**	**4**	**6**	**7**	**4**	**8**	**3**	**10**	**2**

Table 10. Used EEE exported for reuse, by category 2010 - 2050

USED EEE EXPORTED FOR REUSE (kt)	2010	2020	2022	2030 BaU	2030 CE	2040 BaU	2040 CE	2050 BaU	2050 CE
1. Temperature exchange equipment	0	8	6	8	7.2	10.5	7.3	12	5.3
2. Screens, monitors	0	9	9.5	6.7	3.8	4.8	1.4	4.8	0.9
3. Lamps	0	0	0	0	0	0	0	0	0
4a. Large equipment (excluding photovoltaics)	0	1.9	0.8	9.9	3.2	12.4	3.6	13.5	3
4b. Photovoltaics	0	0	0	0	0	0	0	0	0
5. Small equipment	0	0	0	0	0	0	0	0	0
6. Small IT and telecommunication equipment	0	4.2	3.5	3.3	2.4	3.5	1.6	3.8	0.9
TOTAL	**0**	**23**	**20**	**28**	**17**	**31**	**14**	**34**	**10**

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