

# Collection of Electronic Waste (Innsamling av EE-avfall)



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REPORT NO.  
[Report No.]

YEAR  
2021

**ISBN NO.**  
[xxx-xx-xxxx-xxx-x]

**ISSN NO.**  
2535-812X

**REPORT TYPE**  
[Report Type]

**CONFIDENTIALITY**  
[Availability]



**PROJECT TITLE**

*Collection of Electronic Waste (Innsamling av EE-avfall)*

**PROJECT NUMBER**

3139

**COMMISSIONED BY**

Norsk Industri

**REFERENCE**

Gunnar Grini

**INTERNAL QUALITY CONTROL**

Ole Jørgen Hanssen

**NUMBER OF PAGES**

32

**KEY WORDS**

[WEEE, Collection, Recycling, POM, Waste Generated]

**PHOTO FRONTPAGE**

[UNU / UNITAR]

## Summary

This study answers a call from Norsk Industri, Norsk Returmetallforening, Renas, Norsirk and Recipo for a study on differences in the levels of sold EE products and WEEE collected in Norway in recent years. It represents a follow-up to an earlier study by mostly the same project team in 2018, captured in the “Norwegian WEEE Flows” report.

The study makes use of more recent data, and up-to-date analyses thereof, across Europe as a whole and for specific countries therein. The study also conducted consultations with relevant stakeholders (including producer responsibility organisations, recyclers, and the Norwegian Environment Agency).

The study firstly addresses current data for WEEE and trends therein, to bring the picture of the current WEEE situation in Norway up to date. Changes in product categorisation and reporting requirements mean that the most recent data are quite uncertain – recent trends in data will become clearer as additional annual datasets under the new reporting regime become available.

Previous studies show that a host of factors contribute to WEEE data and trends therein. These include a range of WEEE flows outside producer compliance schemes, variability in interpretation and implementation of the WEEE Directive in different countries, and consumer behaviour / economics.

Trends in Norwegian WEEE data, and particularly the gap between EEE put-on-market (or waste generated) and that collected, can be related to the data themselves and the value chains from which the data emerge. Potential inaccuracies in existing data are identified, and pathways to reducing these, hence improving Norway’s performance relative to the requirements of the WEEE Directive are identified. These concern more accurate registration of EEE and WEEE, particularly with respect to the effect of packaging and the potential for non-EEE to be registered incorrectly.

Reduction in weaknesses in the underlying value chains, resulting in so-called “complementary flows” of WEEE, are a less promising route to improving overall national performance. Nonetheless a number of sources of weakness in the value chain are identified.

Effectively addressing these issues will not occur without changes in the policy sphere. Suggestions are made for potential developments, broadly supporting the position of the producer responsibility sector who identify a reconfiguration of responsibilities along the value chain as the most important driver for future improvement.

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# 1 Introduction

WEEE, which is inappropriately handled and treated, represents a serious environmental, social, and economic threat. Regulatory attempts to prevent and/or ameliorate the problems associated with WEEE have increased in pace worldwide over recent decades. In Europe, the WEEE Directive was first put into effect by the European Parliament in 2003 and recast in 2012. Its purpose is to reduce impactful disposal and to enhance the retrieval of valuable resources through recycling, reuse, and recovery and to prevent the emergence of WEEE.

A central tenet of the Directive and its recast is that of WEEE collection rates; these are specified at the level of individual Member States (MS) and require MS to meet minimum collection targets for WEEE in specific categories. These have evolved from simple weight per capita targets to targets purportedly reflecting the amount of WEEE available for collection, based (for example) on the amounts of electronic equipment produced and/or sold (i.e., put-on-market or POM) within MS.

The present study was motivated by the observation that Norwegian WEEE collection rates have fallen short of the most recent minimum collection targets – Norway was well in excess of earlier targets, but the recent picture is different. Moreover, it has been observed that collection rates in Norway have apparently declined in recent years. The study seeks explanations for these trends and attempts to quantify the effect of the various contributory factors. It builds upon and brings up-to-date previous broadly similar studies.

The work is divided into four main Work Packages which fall into two (strictly consecutive) parts. The first part comprises WP1 and WP2 and attempts to document the existing position and trends therein, focusing on the Norwegian context but also comparing with other countries across Europe. WP1 deals primarily with collection data and WP2 covers explanations and analysis of those data that have been offered to date. Part 2 comprises WP3 and WP4 and represents a more detailed, up-to-date, and Norway-focused analysis. The main focus is compliance with the requirements of the Directive, investigation of shortcomings and consideration of potential ways forward. There are two fundamental issues – those primarily relating to measurement, accounting, and reporting of WEEE (WP3) and those relating to the WEEE value chain itself (WP4).

## 2 Work Package 1: the current / recent Norwegian situation and international comparisons

This Work Package focuses on collating and assimilating relevant data on WEEE collection rates, mostly focused on Norway but also considering other European countries. Many of the issues facing Norway are seen to varying degrees across Europe; this is considered briefly. One key issue relates to the basis of reporting – the Directive offers MS the option to report on the basis of electronic equipment placed-on-market or on WEEE generated. The implications of this are discussed.

The two main elements of data relating to WEEE are those pertaining to its collection and those pertaining to the available WEEE for collection (POM and/or waste generated). These data are collated for Norway and considered in a wider European context over the past decade. Finally, the data are considered in the perspective of compliance (or lack thereof) with the Directive. It should be emphasised that the intention of the Work Package is to document and present the data. Analysis and explanation thereof are reserved for later parts of the study and are kept to a minimum at this point.

### 2.1 The Europe-wide context

Recent analyses such as those conducted by the United Nations Institute for Training and Research (Baldé et al., 2020b) show a fairly consistent picture across Europe. Non-compliance with the most recent iteration of the Directive is almost universal; collection rates of WEEE well below the minimum requirements of the Directive are reported in almost all European countries. It appears that only Bulgaria, Croatia, and Switzerland are presently in compliance with the Directive's requirements. There are suspicions over the data from Bulgaria and Croatia, and unique features of the Swiss value chain such as actors being financially incentivised to collect and recycle WEEE. This means that there are essentially zero cases of existing compliance. The community of electronics producers, represented by umbrella bodies termed Producer Responsibility Organisations or PROs, have suggested (WEEE Forum, 2020) that this in itself suggests a revision of the requirements to be necessary.

The UNiTAR study (Baldé et al., 2020b) was commissioned by the PROs and identifies a range of factors that influence WEEE collection – these are considered further in WP2 (Chapter 3). They encompass relevant material flows outside official systems, the implementation of legislation at national level and consumer-behavioural factors. Some geographical differences across Europe are identified, with western European countries apparently being furthest from compliance.

### 2.2 Basis of reporting

The Directive allows for Member States to report WEEE collection as a fraction of the mass of electronic products put on the market in the preceding years (the EE-POM basis) or as a fraction of the electronic waste generated (the WG basis). These are described and discussed in more detail as part of the work in WP3 (Chapter 4). In principle, WG more accurately represents what WEEE arises and what can realistically be collected.

The choice of reporting method – assuming both methods to be available – should depend on the primary objective behind the entire reporting exercise. If the primary objective is compliance with the Directive or at

least the reduction of distance-to-target under the Directive, then the EEE POM method is probably preferable, since for all countries it is found that 65% EE POM is lower than 85% WG. On the other hand, if the primary objective is the improvement of WEEE value chains and improved collection of WEEE in real terms, the WG method is likely to be a more accurate metric and a more appropriate driver. As discussed further below, alternative metrics are also conceivable.

## 2.3 WEEE Collection Data

This section begins to address the first main research questions underlying Work Package 1, namely:

- *Overall, how does the recent (2016-) Norwegian experience of low and/or declining collection rates compare to other European countries?*
- *How does the Norwegian picture compare with other countries in terms of particular product groups? Are there groups where Norway typically out/under-performs other countries? What are the temporal trends over the past few years?*

The analysis begins by considering the data as presented in Eurostat (2020), the primary basis for reporting under the Directive. Firstly, WEEE collection data in isolation are considered, for the moment ignoring POM, WG or any other factors.

### 2.3.1 Overall collection rates, total and per capita

The most recent data set for 2018 had recently been published at the time of access and was incomplete. Hence, the analysis is restricted to those countries for which 2018 data were available at the time of access, also 2015 to consider near-term trends and 2010 for longer-term trends. These countries are Germany, France, United Kingdom, Spain, Netherlands, Sweden, Belgium, Austria, Norway, Czechia, Denmark, Finland, Ireland, Greece, Latvia, Estonia, Luxembourg, and Liechtenstein. Initial inspection of the data suggested different trends in the Nordic countries (Norway, Sweden, and Denmark) and so these were considered separately to the other 15 countries, which were considered on an aggregate basis.

	WEEE Collected per annum (k tonnes), Eurostat									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	Change*
<b>All countries</b>	2718	2751	2691	2786	2844	3152	3722	3764	3870	42%
<b>All ex Nordic*</b>	2366	2380	2341	2432	2520	2830	3385	3454	3558	50%
<b>Norway</b>	108	110	105	105	107	106	103	99	96	-10%
<b>Sweden</b>	161	177	169	177	145	144	163	141	144	-11%
<b>Denmark</b>	83	84	76	72	72	72	71	70	71	-14%

*Table 1: WEEE collected and trends for 18 European countries, 2010-18. "Ex Nordic" means the 15 countries other than Norway / Sweden / Denmark. "Change" means the variation from 2010-2018*

*Table 1* shows an almost steady trend of increasing WEEE collection across the 18 countries as a whole, from 2.72 million tonnes in 2010 rising by 42% to 3.87 million tonnes in 2018. The non-Nordic countries experienced a 50% rise in collection rate, contrasting sharply with falls of 10-15% in each of the three Nordic countries. Norway, in particular, seems to have experienced a fairly sharp recent decline from 2015 onwards.

Absolute collection amounts do not necessarily give the full picture. Collection rates per capita can be more illustrative and informative. The equivalent of *Table 1* on a per capita basis is shown in



	<i>WEEE Collected, kg per capita (Eurostat)</i>									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	Change*
<b>All countries</b>	7.8	7.9	7.7	8.0	8.1	8.9	10.5	10.6	10.8	38%
<b>All ex Nordic*</b>	7.2	7.3	7.1	7.4	7.6	8.5	10.1	10.3	10.6	46%
<b>Norway</b>	22.0	22.2	20.9	20.7	20.9	20.4	19.6	18.7	18.2	-18%
<b>Sweden</b>	17.2	18.7	17.7	18.4	14.9	14.7	16.5	14.1	14.2	-18%
<b>Denmark</b>	15.0	15.1	13.6	12.8	12.7	12.8	12.4	12.1	12.3	-18%

Table 2. Once again, sharp rises across Europe are in clear contrast with fairly steep declines in the Nordic countries. However, the per capita collection rates across the Nordics remain higher than the European average even after these changes.

	<i>WEEE Collected, kg per capita (Eurostat)</i>									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	Change*
<b>All countries</b>	7.8	7.9	7.7	8.0	8.1	8.9	10.5	10.6	10.8	38%
<b>All ex Nordic*</b>	7.2	7.3	7.1	7.4	7.6	8.5	10.1	10.3	10.6	46%
<b>Norway</b>	22.0	22.2	20.9	20.7	20.9	20.4	19.6	18.7	18.2	-18%
<b>Sweden</b>	17.2	18.7	17.7	18.4	14.9	14.7	16.5	14.1	14.2	-18%
<b>Denmark</b>	15.0	15.1	13.6	12.8	12.7	12.8	12.4	12.1	12.3	-18%

Table 2: WEEE collected and trends for 18 European countries, 2010-18. "Ex Nordic" means the 15 countries other than Norway / Sweden / Denmark. "Change" means the variation from 2010-2018

Explanations and discussion of these data will follow later in the study, in the accounts of Work Packages 3 and 4. Also, the Eurostat data provide an incomplete picture of WEEE collection, particularly in Norway, because of differences in scope (specific product types included or excluded). This is addressed further below.

Notwithstanding these limitations, the following initial conclusions seem reasonably clear:

- WEEE collection rates, both total and per capita, have been increasing across Europe but are in decline across the Nordic region. A 50% increase per capita across Europe over the past decade contrasts strongly with 10%+ falls in the Nordic countries.
- Norway's collection of WEEE shows a fairly sharp decline of 10% in absolute terms and nearly 20% in per capita terms over the past decade.
- The Nordic countries, incl. Norway, still have amongst the highest collection rates in Europe.

### 2.3.2 Collection rates for different product groups

It seems possible that trends in collection rate differ across product groups, and that certain product groups may merit more attention than others. Since historical data are in focus here, the analysis is based on the eleven product categories in the old EU product scope (see the following section for further explanation of product scope). WEEE across different product groups is collected at very different rates. Between 2010 and 2018, around half of all WEEE was from the large household appliances category. The first four product groups in Table 3 below account for over 90% of WEEE collected across Europe.

The change in annual WEEE collected between 2010 and 2018 is shown in Table 3. The data are presented in per capita terms to allow comparability across different populations. Perhaps most striking is the substantial rise in large household appliance collection across Europe, with an additional 2.9 kg per inhabitant (nearly 1 million tonnes) collected across Europe apart from the Nordics. This is in marked contrast with the near-static collection of these devices in Norway and Denmark, and a sharp decline of 0.8 kg per inhabitant in Sweden.



Large (and so some extent small) household appliances account for almost all the increased collection across Europe since 2010. In contrast, collection rates in these groups in Norway have remained nearly constant. The most noticeable declines in Norwegian collection relate to consumer equipment / PV panels, and electrical and electronic tools.

	All countries	All ex Nordic	Norway	Sweden	Denmark
<b>Large household appliances</b>	2.7	2.9	0.2	-0.8	0.3
<b>Small household appliances</b>	0.6	0.6	-0.2	-0.2	0.7
<b>IT and telecommunications equipment</b>	-0.3	-0.2	-0.6	-1.1	-1.6
<b>Consumer equipment / photovoltaic panels</b>	-0.2	-0.1	-1.5	-1.1	-2.6
<b>Lighting equipment</b>	0.2	0.1	0.4	1.0	0.5
<b>Gas discharge lamps</b>	0.0	0.0	0.0	0.0	-0.1
<b>Electrical and electronic tools</b>	0.1	0.1	-0.8	0.2	0.5
<b>Toys, leisure and sports equipment</b>	0.0	0.0	0.0	0.0	0.1
<b>Medical devices</b>	0.0	0.0	0.0	0.0	0.0
<b>Monitoring and control instruments</b>	0.1	0.1	0.2	0.0	0.2
<b>Automatic dispensers</b>	0.0	0.0	0.0	0.0	0.0

Table 3: Change in WEEE collected across different product groups (kg per capita), 2010-2018

These data represent the difference between two annual snapshots. As such, they could be quite sensitive to year-on-year fluctuations and may not give an illustrative picture. To check this, the trends in collection rate across the whole period are presented for the most important product groups. The data in Table 4 for large household appliances show collection rates increasing from around 2014-15 in almost all countries, however these increases were not sustained across the Nordics thereafter, whereas elsewhere the collection rates continued to rise.

	<i>Large household appliances collected, kg per capita (Eurostat)</i>				
	All countries	All ex Nordic	Norway	Sweden	Denmark
2010	3.6	3.3	9.0	8.0	6.4
2011	3.5	3.3	9.5	8.2	6.6
2012	3.5	3.3	9.0	8.3	5.8
2013	3.8	3.6	9.3	9.0	5.8
2014	3.9	3.7	10.1	7.6	5.9
2015	4.6	4.4	10.2	7.7	6.1
2016	5.9	5.8	9.8	8.7	6.9
2017	6.1	6.0	9.2	7.6	7.0
2018	6.3	6.2	9.2	7.2	6.6

Table 4: Collection of large household appliances (kg per capita), 2010-2018

Table 5 shows the equivalent data for consumer equipment and PV panels. Collection rates have seen a small decline across Europe, but a much larger relative fall in the Nordics. The trends seem consistent across the Nordic countries and over time, with sustained year-on-year decline in collection rates from 2012 onwards. In Norway, the decline of 1.5 kg per inhabitant from 2010 to 2018 represents a decline of 7000 tonnes per annum.

The following conclusions appear clear from the data:

- The increase in WEEE collection across Europe in the past decade can largely be attributed to large household devices, and to some degree small household devices
- The decline in WEEE collection in Norway is mostly spread across smaller product groups, but the failure of large appliance collection rates to rise is the biggest factor in the widening gap between Norway and other European countries in recent years.

	<i>Consumer equipment and PV panels collected, kg per capita (Eurostat)</i>				
	<b>All countries</b>	<b>All ex Nordic</b>	<b>Norway</b>	<b>Sweden</b>	<b>Denmark</b>
2010	1.5	1.4	3.8	4.0	4.2
2011	1.6	1.4	3.9	5.2	4.7
2012	1.5	1.4	3.6	4.7	4.1
2013	1.5	1.3	3.4	4.9	3.5
2014	1.4	1.3	3.1	3.6	3.1
2015	1.4	1.3	2.9	3.3	2.9
2016	1.4	1.4	2.7	3.5	2.3
2017	1.3	1.3	2.4	2.6	1.9
2018	1.3	1.3	2.3	2.9	1.6

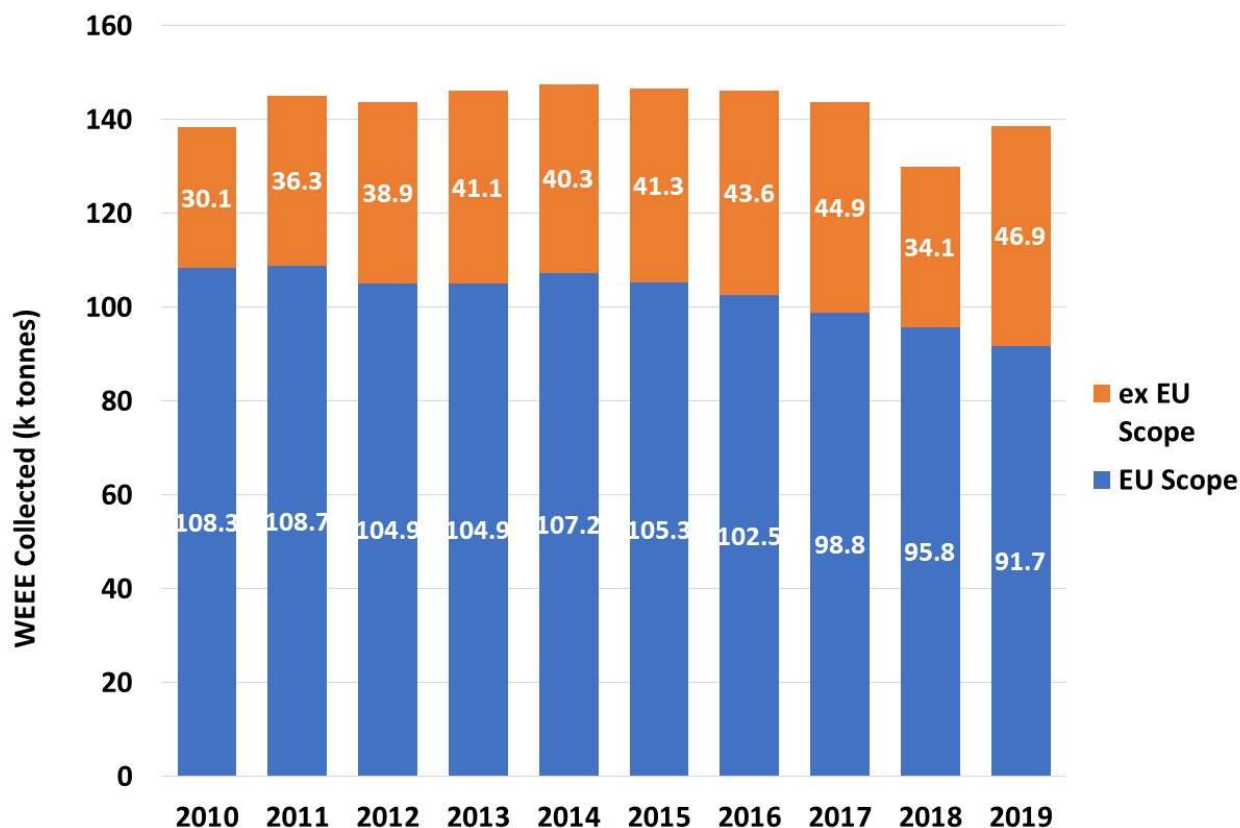
Table 5: Collection of consumer equipment and PV panels (kg per capita), 2010-2018

### 2.3.3 Reconciliation of product categories and scope

As explained previously in “The Norwegian WEEE flows” (Gylling et al., 2018), the types of WEEE historically collected and recorded in Norway (the Norwegian scope) were more wide-ranging than those required under the Directive and reported to the EU (the EU scope). Moreover, more recent changes to the Directive have resulted both in an “open scope” – meaning that all EEE placed on the market must be registered unless specifically excluded – and a new, consolidated list of six WEEE categories which are shown in Table 6 below. Thus far in the study, the data presented have been for the EU scope and are organised under the old product categories. This allows both for historical comparison and for comparison against other EU countries. However, a fuller picture of Norwegian WEEE collection – recognising that reporting and calculation requirements for the Directive do not provide a complete evaluation of the system – requires the wider scope to be examined.

Up to 2018, Norwegian WEEE collection data were reported across 14 product categories (18 including sub-categories) of which 11 were in the EU scope (those categories shown in Table 3 above). From 2019 onwards, collection data were on the basis of six revised product categories. The Norwegian Environment Agency has developed a calculation tool for mapping old product categories onto new (and vice-versa). To allow direct comparison with the 2010-18 data, the 2019 data shown in Figure 1 below were first back-mapped onto the old product categories using this tool, and then separated into EU and ex-EU scope.

The data show that EU scope accounts for around 70-75% of all WEEE collected in Norway, varying slightly from year to year. There are occasional wild fluctuations in collection rates outside the EU scope in particular; this was noted in discussions with the Environment Agency (private communication). These fluctuations are most noticeable for 2018. The product category 13 (electro-technical equipment) was the biggest factor; nearly 7000 tonnes less was recorded in 2018 than in 2017, a fall of nearly 40%. However, according to the reported figures, in 2019 ex-EU scope collection returned roughly to levels expected from historical data.



**Figure 1: Norwegian WEEE collected, in and out of EU scope, 2010-19**

Changes in scope obviously also impinge on the figures for POM and waste generated; these will be considered separately later in the study.

#### 2.3.4 Recent trends in Norwegian data (2017-19)

As outlined above, WEEE collection reporting has recently been in transition because of the changes in scope and equipment categories. In particular, 2019 is the first year for which Norwegian data are reported under the new product category framework. Comparison with earlier data requires a re-mapping of collection data onto product categories, either from old to new or vice versa. The matter is further complicated by the fact that, according to the Environment Agency's remapping, fractions of some old WEEE categories formerly ex-EU scope are now within the EU scope (and vice versa) following the recategorization. This means that total WEEE collected before and after the recategorization can be reconciled, but the split between EU and ex-EU scope is not directly comparable.

For example, the remapping suggests that only 40% of the old category 7 ("electronic tools") remains within the EU scope, with the other 60% now mapped onto the new category 7 ("large industrial equipment") which is now ex-EU scope. In contrast, for the old category 13 ("electrotechnical equipment") which was ex-EU scope, 75% of this category by mass remains ex-EU scope whereas 25% is now mapped onto category 5 ("small equipment") which is in EU scope.

With these limitations in mind, Table 6 shows the most recent data for Norway, re-mapped as necessary onto the new EU Directive categories. The 2019 data are drawn directly from the reporting database of the

Environment Agency, whereas the 2017-18 data are re-mapped from data originally reported using the old product categories.

		Norway: WEEE collected (tonnes)		
		2017	2018	2019
1	Temperature exchange equipment	18998	18770	18168
2	Screens, monitors, and equipment containing screens having a surface greater than 100cm <sup>2</sup>	7705	5714	6843
3	Lamps	1148	1069	1099
4	Large equipment > 50 cm	39090	35671	38304
5	Small equipment < 50 cm	33554	35068	32772
6	Small IT and telecommunication equipment < 50 cm	6862	5825	6398
7	Large industrial equipment	20999	11791	19230
8	Large industrial cables	15394	15951	15751
	Total	<b>143750</b>	<b>129858</b>	<b>138565</b>
	Total (EU Scope)	<b>107357</b>	<b>102116</b>	<b>103584</b>

Table 6: Recent trends in Norwegian WEEE collection (new EU Directive categories). Categories in the EU scope are shaded.

### 2.3.5 Summary of findings on WEEE collection data

- There appeared to be a significant fall in total collection rate in 2018, largely due to fluctuations in collection in categories outside the EU scope, but this recovered in 2019.
- It seems clear that Norway, alongside other Nordic countries, has failed to realise the substantial increase in WEEE collected typical of most European countries over the past decade.
- Large household devices seem to be the main source of increased WEEE collection across Europe. Collection rates of these in Norway are static at best and may be in continuing decline.

## 2.4 EEE POM Data

This section considers data for electronic products placed on the market (EEE POM) over recent years. The same 18 countries are considered as for the WEEE collected data in the previous section.

### 2.4.1 Overall EEE POM rates, total and per capita

Tables 7 and 8 show the EEE POM in the same way as the earlier WEEE collected data, in absolute and per capita form. These data are from Eurostat and hence refer to the (“old”) EU scope.

	EEE POM per annum (k tonnes), Eurostat									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	Change*
<b>All countries</b>	7629	7476	7310	7013	7399	7892	8113	8424	8908	17%
<b>All ex Nordic*</b>	7067	6918	6763	6451	6827	7303	7513	7788	8253	17%
<b>Norway</b>	182	185	186	181	182	178	183	186	191	5%
<b>Sweden</b>	232	232	219	243	238	257	259	279	288	24%
<b>Denmark</b>	148	142	142	138	152	155	159	172	176	19%

Table 7: EEE POM and trends for 18 European countries, 2010-18. “Ex Nordic” means the 15 countries other than Norway / Sweden / Denmark. “Change” means the variation from 2010-2018

	EEE POM, kg per capita (Eurostat)									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	Change*
<b>All countries</b>	22.0	21.5	21.0	20.1	21.1	22.4	22.9	23.7	24.9	13%
<b>All ex Nordic*</b>	21.6	21.2	20.6	19.6	20.7	22.0	22.5	23.2	24.5	14%
<b>Norway</b>	37.1	37.3	37.1	35.6	35.5	34.2	34.9	35.2	36.0	-3%
<b>Sweden</b>	24.8	24.5	23.0	25.3	24.5	26.2	26.1	27.7	28.3	14%
<b>Denmark</b>	26.6	25.5	25.4	24.7	27.0	27.2	27.7	29.8	30.3	14%

Table 8: EEE POM and trends for 18 European countries, per capita, 2010-18. “Ex Nordic” means the 15 countries other than Norway / Sweden / Denmark. “Change” means the variation from 2010-2018

The general trend across Europe is a decline in POM across the first half of the decade – thought to be related to the economic downturn of the late 2000s – followed by a rise across the rest of the decade. Overall EEE POM rose faster than population resulting in an increased POM per capita overall, except in Norway where there was a marginal decrease. The absolute level of POM per capita is higher in the Nordic countries and particularly high in Norway; any closing of the gap between Norway and the rest of Europe in this respect is very marginal at most.

## 2.4.2 POM for different product groups

In this section the POM across the different product groups (once again the original WEEE Directive categories) is compared. As for WEEE collected, the main focus is per capita data to allow like-for-like comparison. Table 9 shows the temporal trends for Norway over the decade, with a spot value of the most recent data across the 15 non-Nordic countries shown for comparison. The temporal trends for the non-Nordic countries are not shown but a generally steady increase in POM, as reflected in the overall data in Table 8, was seen across most product groups.

The Table shows that whilst total Norwegian POM was rather constant over the decade, there were some fairly significant shifts between product groups, notably away from Group 4 and towards Group 10. It seems possible these shifts could reflect categorisation / reporting changes as well as real shifts in the electronics market. For example, it seems counterintuitive that the POM for PV panels has fallen over the decade – but it may be that PV panels only constitute a small fraction of Group 4 as a whole. There were earlier examples – for instance between 2013 and 2014 – of shifts between product groups yet a near-constant overall POM rate. Intuitively it seems unlikely that radical short-term market shifts explain these data; reporting inconsistencies and changes seem more plausible. The overall higher level of POM in Norway compared to the non-Nordic countries can be linked mostly to lighting equipment, electrical and electronic tools, and monitoring and control instruments. Once again, reporting details may be a factor alongside real relative differences in the relevant electronics markets.

## 2.4.3 Summary of findings on EEE POM data

- On both an absolute and a per capita basis, annual EEE POM in Norway has remained nearly constant over recent years, in contrast with other Nordic and European countries which have seen rises in EEE POM.

- EEE POM across most product groups reflects the overall trend of remaining largely constant, there were some shifts away from groups including consumer equipment / PV panels (24000 tonnes in 2010 halved to 12000 tonnes in 2018) and towards other groups such as monitoring and control instruments (22000 tonnes in 2010 up to 36000 tonnes in 2018).

	<i>EEE POM, kg per capita (Eurostat)</i>									
	Norway									Non-Nordic*
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018
Large household appliances	13.4	13.5	14.0	14.6	12.9	12.9	14.0	13.4	13.6	12.1
Small household appliances	3.2	3.3	3.3	3.4	3.2	2.9	2.9	2.9	3.1	2.2
IT and telecommunications equipment	3.3	4.8	4.8	4.9	4.6	3.9	3.2	3.2	3.1	2.5
Consumer equipment / photovoltaic panels	5.2	4.4	4.0	3.5	3.3	2.6	2.4	2.6	2.4	2.9
Lighting equipment	6.6	5.1	5.3	5.2	4.7	5.1	4.6	4.9	4.7	1.1
Gas discharge lamps	0.6	0.6	0.6	0.5	0.5	0.4	0.3	0.4	0.4	0.1
Electrical and electronic tools	3.0	3.2	3.0	1.7	3.4	3.1	3.6	3.8	4.5	1.7
Toys, leisure and sports equipment	0.9	0.8	0.6	0.6	1.0	1.0	1.0	1.0	1.2	0.8
Medical devices	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Monitoring and control instruments	0.5	1.2	0.9	0.9	1.6	1.9	2.5	2.6	2.8	0.6
Automatic dispensers	0.3	0.4	0.2	0.2	0.2	0.3	0.1	0.1	0.1	0.2
<b>Total</b>	<b>37.1</b>	<b>37.3</b>	<b>37.1</b>	<b>35.6</b>	<b>35.5</b>	<b>34.2</b>	<b>34.9</b>	<b>35.2</b>	<b>36.0</b>	<b>24.5</b>

Table 9: EEE POM per capita in product groups, for Norway (2010-18) and weighted average for 15 non-Nordic countries (2018 only)

## 2.5 Compliance with the Directive

Compliance with the Directive is in theory achievable on either the EE POM basis or the WG basis. The UNITAR study (Baldé et al., 2020b) shows that the WG basis is more onerous for all European countries, requiring collection rates between 10% and 60% higher than required on the EE POM basis. This is a simple empirical observation, stemming from an apparent miscalculation in setting the Directive's targets, whereby 65% EE POM is almost inevitably a lower amount than 85% WG. This is highly location-dependent, but it seems clear that if the primary objective is reducing distance-to-target under the Directive then the EE POM basis will be the choice for Norway at present and for the foreseeable future. Hence, for the purposes of mapping (potential) compliance with the Directive, the present study will focus on EE POM, although WG will be kept in mind as it arguably reflects a more accurate reflection of the value chain.

Table 10 shows the collection rate as a fraction of EE POM across Europe. The data are calculated retrospectively to 2012, although the EE POM basis for collection target was not in place then. The data show that with very few exceptions (Sweden early in the decade) that Europe as a whole, and most countries within it, fall far short of the minimum collection rates in the Directive. Moreover, this would have been the case for the whole decade if these POM-based targets had been in place.

In accord with the earlier findings for Europe as whole, with collection rates rising much faster than POM, the percentage of POM collected has steadily risen throughout the decade, although this seems to have plateaued in the most recent two years or so.

	2012	2013	2014	2015	2016	2017	2018
<b>All countries</b>	37%	40%	38%	40%	46%	45%	43%
<b>All ex Nordic*</b>	35%	38%	37%	39%	45%	44%	43%
<b>Norway</b>	56%	58%	59%	59%	56%	53%	50%
<b>Sweden</b>	77%	73%	61%	56%	63%	51%	50%
<b>Denmark</b>	54%	52%	47%	47%	45%	41%	40%

*Table 10: WEEE collected as a percentage of EE POM over the preceding three years, 2012-18. "Ex Nordic" means the 15 countries other than Norway / Sweden / Denmark.*

Norway continues to outperform much of Europe and based on the most recent data remains in the top third or so of all countries, there appears to be a small decline in the data to 2018 but when the 2019 POM data become available it is possible this will be reversed. Based on the most recent available data, only Estonia and Ireland are possibly close to the 65% POM target.

## 2.6 Conclusions for WP1

This section recaps the main research questions for WP1 and the most important findings.

- *Overall, how does the recent (2016-) Norwegian experience of low and/or declining collection rates compare to other European countries?*

Very recent trends should probably not be over-interpreted. Recent changes in reporting requirements and product categorisations cannot be ignored and seem likely to cloud the data. The 2018 data suggest a pessimistic picture in terms of WEEE collected, but it appears that collection rates have rebounded somewhat in 2019. More generally, it seems prudent to consider the developing picture over the next 1-2 years before drawing very firm conclusions. Discussions with actors in the WEEE value chain including the Producer Responsibility Organisations (private communications) seem to support this point.

Based on currently available data, direct comparisons with other countries are only possible for products in the (old) EU scope. Over the decade as a whole, collection rates of Norwegian WEEE in the EU scope have been in decline. Other Scandinavian countries see a similar trend. This is in contrast to an ongoing rise in collection rates across Europe as a whole.

- *How does the Norwegian picture compare with other countries in terms of particular product groups? Are there groups where Norway typically out/under-performs other countries? What are the temporal trends over the past few years?*



Large household appliances are the most important product group overall, and the fluctuations in this group account for a large part of the overall changes in collection rates. Europe has generally seen sharp increases in large household appliance collection over the past decade, which has not been replicated in Norway (or the other Nordic countries).

Overall WEEE collection rates (per capita) in Norway remain the highest in Europe, but this is at least in part explained through existing and historical POM rates which are also the highest in Europe by far. Norway collects WEEE in large quantities, but both historical and present POM rates are high, suggesting large amounts of WEEE should be available.

### 3 Work Package 2: Explanation of recent data and trends, for Norway and across Europe

This Work Package briefly assimilates previous analyses and explanations of factors influencing the WEEE data and trends therein. There is broad consensus on the main factors, although less so on the division of responsibilities. Much of this is already described in detail in the “Norwegian WEEE Flows” report (Gylling et al., 2018) and the more recent UNITAR report (Baldé et al., 2020b) gives a broader European perspective. Also, parts of this analysis are included in the discussions of Work Packages 3 and 4, so only a brief summary will be outlined here.

#### 3.1 WEEE flows outside producer compliance schemes

A producer compliance scheme (PCS) is a membership organisation typically managed by a Producer Responsibility Organisation (PRO) which manages the producers’ legal responsibilities for collecting and reporting WEEE under the auspices of the Directive. In Norway, as in most other countries in Europe, national WEEE activity under the Directive is defined as the sum total of the activities of the relevant PCSs.

WEEE collection within PCSs is fundamentally configured as WEEE presenting a waste management problem, the costs of which are to be properly allocated and borne by the appropriate actors. More specifically any economic value of end-of-life EEE is not considered. This impedes collection in practice since such economic value is clearly tangible for a range of actors, both legal and illegal. The value can derive from EEE as second-hand products or in the potential to extract valuable materials.

Previous analyses have identified a number of flows of WEEE outside PCSs:

- WEEE collected with metal scrap. These flows may well be recycled, and done so in legal fashion with proper handling of the waste, by actors holding the requisite permits, and yet not be declared as WEEE or reported under the Directive (Baldé et al., 2020b). These flows are mostly made up of large products with a high share of metal. Some of this flow is handled in scrapyards or largescale shredders, while other parts are exported for processing. There are no studies to our knowledge that derive a specific estimate of this flow for Norway. The UNITAR report (Baldé et al., 2020b) estimates an annual level of around 1.0 kg/inhabitant for Northern Europe, this corresponds to around 5% of WEEE collected if all WEEE in metal scrap were in EU scope.
- WEEE in residual waste – that discarded in waste bins, either in private households or in business / 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. Estimates of the level of WEEE in residual waste vary, although it is probably in the range between the estimates in the “Norwegian WEEE flows” study (Gylling et al., 2018) and the UNITAR study (Baldé et al., 2020b) which were around 1.0 and 2.0 kg per inhabitant respectively.
- Products exported for reuse - the products in this flow do not become waste in the country where the product is put on the market and are therefore not recorded as WEEE in this country. Baldé et al. (2020b) found that the exported used-EEE flow mostly consists of b2b equipment in the Northern and Western European countries. It is also assumed that some of the flow stems from private households and includes products such as laptops, phones and other small household equipment. Exports of used EEE are in principle legitimate but can also be used unscrupulously to conceal exports of WEEE, which are illegal. Also, illegally exported WEEE can be mixed with metal

scrap. Hence, the amounts of illegally exported WEEE can be hard to separate / discern from other flows. Specific estimates of EEE and WEEE exports seem even less certain than those for the other flows, but perhaps 1-2 kg per inhabitant per annum is possible.

### 3.2 Implementation and interpretation of the Directive

All Member States are obliged to meet the objectives of the WEEE Directive, but how it is implemented is up to each state. Arguably one of the most important inconsistencies in implementation concerns the use of “substantiated estimates” which are permitted under the Directive for reporting elements of WEEE that cannot be captured by “official” data (meaning data linked with producer compliance schemes).

In essence, substantiated estimates are a way of quantifying (some of the) flows outside producer compliance schemes identified above, in such a way that they can be reported under the Directive. The use of substantiated estimates to date is relatively rare (Baldé et al., 2020b), being restricted to Austria, the United Kingdom and Portugal, with several other member states looking at the issue. For Austria and the UK in particular, the approach used seems quite reasonable – the estimates are used to capture metal scrap flows where the treatment was compliant with regulations and hence its inclusion under the Directive seems quite justifiable. It seems possible that substantiated estimates could be used to capture the legally collected and properly handled WEEE with metal scrap in Norway.

Substantiated estimates are strongly opposed by some actors, notably the recyclers – who believe the use of substantiated estimates affect the proper collection of WEEE and should be phased out (European Electronics Recyclers Association, 2019). However, some of their claims seem dubious such as the claim that substantiated estimated streams are “... almost certainly not de-polluted, hence illegally treated...”

Switzerland provides an example of implementing the Directive in a quite different way to most other countries. Direct financial incentives are provided for the collection of WEEE, with the compensation for sorted collection available to all actors and set at a sufficiently high level (apparently in excess of base cost) to stimulate collection and registration (Baldé et al., 2020b). This seems to positively influence collection rates but comes at considerable cost. One outcome is that most scrap metal dealers are within the producer compliance schemes and the final level of WEEE mixed with metal scrap is limited (Baldé et al., 2020b).

The Swiss experience shows some features of recent analyses conducted on behalf of the producers (Baldé et al. (2020b); WEEE Forum (2020)) – where a so-called all-actors approach (AAA) is a strong driver of increased collection rates. The AAA brings actors other than the producers (PROs) into the formal mechanism for collecting and reporting WEEE – essentially meaning that other actors (retailers, local authorities, recyclers, brokers and dealers, end-users, reuse actors and so on) have legal responsibilities for reporting under the Directive that currently apply only to producer compliance schemes, moreover that actors outside PCSs are subject to monitoring and follow-up under the Directive. There is some evidence – not completely definitive – that countries adopting an AAA tend to have higher collection rates. The AAA is central to the proposed Waste Available for Collection (WAFc) metric as outlined in Chapter 4.

### 3.3 Behavioural and economic factors

Hoarding of WEEE and second-hand use of used EEE in principle influence collection rates as the behaviour extends the lifespan of products. At the level of individuals or households, changes in hoarding behaviour

could have a profound influence on WEEE data. However, at the scale of entire countries, hoarding has been shown to be largely an equilibrium process, meaning that the amount of newly hoarded electronics in any given period is largely balanced by previously hoarded electronics being finally sent for disposal in the same period. Some perturbations to this equilibrium are noted – for example campaigns to encourage disposal of hoarded WEEE are generally successful and result in short-term surges in collection rates, but these soon decline to “equilibrium” levels once again (Baldé et al., 2020b). A detailed analysis in the UK (Sayers et al., 2020) showed the flows into and out of hoarding to be relatively large (around 2.7 kg per inhabitant) but almost equal to each other, thus maintaining the equilibrium. The underlying residual stock of “hoarded” (non-functional or rarely-used) EEE may be very large – estimates of 20 kg per inhabitant have been derived (Baldé et al., 2020b) – but the net flow in or out of this stock, which is what matters for WEEE data, is remarkably small.

Disruptions to the underlying equilibrium in WEEE data could also stem from changes in demographics and/or the underlying housing stock. Examples pertinent to Norway include a decline in population per household (meaning an increased number of discrete households for a given overall population) and the (increased) building of holiday homes. Both of these might be expected to increase POM relative to WEEE collected, as individuals would on average possess more EEE products than otherwise. However, analysis of data from Statistics Norway<sup>1</sup> suggests any such effects are fairly marginal. From 2010-2020, the number of Norwegian households increased from 2.17 to 2.48 million, an increase of just over 300 000. In the same period, the number of individuals per household declined from 2.22 to 2.15. This means that only one-quarter of the additional households (around 80 000) is attributable to changes per household, the remainder being attributable to overall population increase. Data on housing stock<sup>2</sup> show that new holiday homes (around 7 000 per annum) contribute similarly to the total number of households. Altogether it looks fairly clear that these changes will have a limited overall effect on WEEE data.

The economic cycle of a country or region will also affect the collection of WEEE (Baldé et al., 2020b). An increase in purchasing power parity, leading to an increase in material consumption is correlated with an increase in WEEE collection, and a higher WEEE Generated. Similarly, the collection of WEEE decreases in the times of decrease in purchasing power parity. Thus, it is necessary to adjust the WEEE Generated downwards during economic recessions. (Baldé et al., 2020b) found that this correlation is weaker for the Northern European countries than for the other European regions, but significant ( $R^2 = 0,33$ ).

### 3.4 Uncertainties and varying scopes

It seems clear that the primary source studies we have examined here (Gylling et al., 2018); (Baldé et al., 2020b) did not address error or uncertainty in the data in much detail. Gylling et al. (2018) concluded that the general errors and uncertainties in POM were relatively small and small year-on-year fluctuations indicating low random errors. They suggested potential errors and uncertainties in measurements of WEEE collected, and the differences between the Norwegian and European scope to be more significant. Baldé et al. (2020b) suggested a potential error of perhaps 10% in WEEE Generated and a much lower uncertainty in EE POM. Neither study considered errors and uncertainties in WEEE collected in much detail.

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<sup>1</sup> <https://www.ssb.no/en/statbank/table/10986/>

<sup>2</sup> <https://www.ssb.no/en/statbank/table/06952/>

The present study gives a more comprehensive and updated examination of all these factors in the Norwegian context across Chapters 2, 4 and 5 of this report.

### 3.5 WP2: conclusions

Historical analyses suggest many factors contribute to the level of WEEE collected, generated or put-on-market, and the struggle for compliance with the Directive. Perhaps foremost among them are flows of WEEE outside producer compliance schemes and hence the reporting domain of the Directive, such as WEEE sorted as metal scrap, WEEE thrown in the mixed residual waste in households or businesses, illegal exports of WEEE, and products exported for reuse. Some of those flows could in principle be brought under the umbrella of the Directive, for instance by the use of substantiated estimates. This, and other policy / implementation factors such as the AAA, could have a significant influence on the value chain and hence the data.

Particular product groups are vulnerable to certain pressures – for instance large white goods contain large amounts of metal and present attractive options for discarding as metal scrap. These and some other product groups are vulnerable to theft which may result in illegal export. However, for most product groups the overall pressures and vulnerabilities appear rather similar.

Previous studies have apparently underplayed inaccuracies and uncertainties in data relating both to EEE POM and to WEEE collected. These are considered further in Chapter 4.

## 4 Work Package 3: Accuracy and uncertainty in Norwegian WEEE Data

As seen from Work Package 1, Norway (alongside most other Member States) remains a long way from compliance with the Directive. Work Package 2 highlights the historical explanations for this observation – these can be classified as: (a) issues concerning data, recording and measurement, and (b) issues relating to weaknesses in the value chain itself. The former will be considered here, and the latter in Work Package 4. The distinction between the two is not always clear and sharp but is nonetheless important – primarily in terms of identifying the parties with principal responsibility for addressing particular issues.

The research questions for WP3 are as follows:

- a) To what degree do reporting / accounting uncertainties contribute to the shortfall in reported WEEE collection rates?
- b) What is the relative importance of factors relating to POM and WEEE collected statistics (particularly reduction rates and preparation for reuse)?
- c) Do the data for particular product groups behave differently from others?

These questions were addressed through a combination of desk research, calculations, and conversations with key actors. The study is presented as follows. Firstly, different metrics and measurement approaches are considered. Then, given the present reporting regime, likely inaccuracies and uncertainties are mapped, with clear pathways identified to elements of a revised calculation methodology based on updated reduction factors. Finally, the study makes a vital consideration - where the boundary lies between uncertainties in data and weaknesses in the value chain (i.e., complementary flows, as discussed in WP4).

### 4.1 Metrics and measurements for WEEE

As outlined in the description of Work Package 1, there are two ways in which the WEEE value chain may be evaluated under the current iteration of the Directive.

The **EE-POM basis** is the current basis for reporting for all Member States. Its most obvious features are its straightforwardness and calculability from readily available data. In practice, it is mostly used since it invariably presents a far less demanding target than the alternative. This is an obvious shortcoming of the methodology since different reporting options should capture value chain performance in a nearly equivalent way. Also, the intrinsic shortcomings of EE-POM are well-documented and widely understood. It represents a very indirect (at best) measure of the expected performance of the WEEE value chain, which should relate to that EEE actually discarded by end-users. Moreover, POM itself and hence the metric based upon it has been shown to be highly sensitive to factors largely unrelated to WEEE collection, not least fluctuating economic conditions leading to changes in consumer purchasing power and hence POM. In addition, where consumer markets are volatile and/or the products have long lifespans, the relationship between POM and WEEE generated is even more remote than for other products.

The **Waste Generated (WG) basis** is offered in the Directive as an alternative for Member States. It represents an attempt to address some of the problems of EE-POM, mostly the fact that equipment placed on market is rarely discarded within the same reporting period. WG requires much more complicated calculations than EE-POM, although these are facilitated via common methodology and key country-specific data embedded in calculation tools developed by the EU (although not for Norway). Nonetheless, the data and calculation

requirements of WG are much higher than those of EE-POM. More simply, it has been shown conclusively that 85% of WG (the requirement in the Directive) is a markedly more onerous target than 65% EE-POM – and it is thus quite unlikely that it will be adopted by Member States, including Norway, in the foreseeable future.

In addition to the two existing options, there are possible alternative metrics:

As part of their collective vision for change in the sector (WEEE Forum, 2020), the PROs present an alternative metric named the **Waste Available for Collection (WafC) basis**. This is defined as the PROs (hence the producers) having direct responsibility only for material deposited at designated collection facilities. This is reflected in part of the legal text (Article 12.1 of the Directive) however this is presented as a minimum requirement and it is further specified in Article 12.2 that Member States may require producers to bear responsibility for matters upstream of collection facilities. Note also that this refers to WEEE from private households – for WEEE from other sources Article 13 makes it clear that producers bear responsibility both for collection and for downstream elements. Part of the argument centres on the extent to which producers hence PROs *should* have responsibility along the value chain. The PROs claim that “extended producer responsibility” does not mean “exclusive producer responsibility” (WEEE Forum, 2020). However, very early definitions of the principle appear to make it clear that producers *do* bear sole responsibility for their products: “[EPR] is an environmental protection strategy to reach an environmental objective of a decreased total environmental impact of a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal” (Lindhqvist and Lidgren, 1992). It is certainly fair to note that there are parts of the value chain where the PROs have little leverage or influence, but that the producers (should) bear no responsibility whatsoever for anything upstream of dedicated collection facilities is at best questionable. The most convincing arguments for the AAA and hence the WafC metric relate to efficacy more than to fundamental principle. There is some positive evidence – which nonetheless does not appear completely compelling – that an AAA can lead to increased collection rates. There nonetheless seems to be a danger that the fraction of WEEE entering properly recorded and fully accounted-for channels could fall, and the overall efficacy of the value chain could be in some jeopardy. It is easy to envisage perverse incentives for unscrupulous actors to keep material outside official compliance schemes. Of course, the principle of AAA is to narrow – and perhaps eliminate – the gap between official and non-official channels, but it seems clear that this is a remote prospect in practice. WafC makes sense under an AAA but nonetheless appears to narrow the responsibilities of producers with little concrete guarantee that the shared responsibilities would be properly fulfilled and that it would improve matters overall. Also, it is naturally only a partial measure of WEEE collection performance within a Member State, and additional metrics and measurements would be required.

It is possible to conceive a broader definition of “waste available for collection” that improves upon waste generated as an appropriate metric for the expected performance of the WEEE value chain. A specific example is useful for illustration.

As outlined in Work Package 1, the past decade has seen a notable increase in large household appliance collection across Europe of nearly 3 kg per inhabitant across the board. This is in contrast with Norway and the other Nordic countries which have seen largely static or even falling collection rates of these appliances. Naturally, increases in POM could not nearly explain the rise in collection rate. It seems rather unlikely that waste generated could explain the phenomenon either, for if this were the case then we would not expect quite different trends in the Nordics. A possible explanation might be found in trends not just of historical POM (as manifest in waste generated) but also historical *collection*. It is well-known that absolute collection rates in the Nordics were much higher than elsewhere in Europe prior to 2010. To some extent these would



reflect higher overall consumption rates for electronics (hence historical POM), but it is certainly also possible that there was relatively more assiduous collection in the Nordic region than elsewhere through the 2000s, and that Europe has effectively played catch-up over the subsequent decade. This then leads to the question of whether the additional collected WEEE in Europe over the 2010s could be captured through a modified “waste available for collection” metric, or whether it should have been regarded as “hibernating stock” which is considered in WP4. The key distinction is that hibernating stock is effectively deemed as reasonably available for collection, whereas under the modified WafC metric it would not be considered as such. This concept is not fully developed but it serves to highlight the possibility of alternative metrics and the blurring of boundaries between shortcomings in data (WP3) and shortcomings in the value chain (WP4).

At least in the short-term, these considerations of potential alternative metrics can be considered irrelevant in practice since EE-POM is the current system and there is little sign of immediate change. With that in mind, the study’s attention now turns to uncertainty within the present reporting regime.

## 4.2 Uncertainties and inaccuracies in the present (EE-POM) reporting regime

For all its shortcomings, EE-POM looks like the basis for reporting for at least the immediate future. The “Norwegian WEEE Flows” study (Gylling et al., 2018) highlighted a number of shortcomings in terms of data, measurements and the value chain itself. The analysis, particularly for data-related issues, was largely qualitative. The present study attempts a more quantitative analysis in several respects.

The overall national performance in terms of the Directive depends on the measurement of POM and the measurement of WEEE collected. Uncertainties and inaccuracies in data are seen to mostly refer to the former. Uncertainties in WEEE collected are usually regarded in the context of “complementary flows” (see WP4), although as mentioned above the boundary between those flows and measurement errors is blurry. Nonetheless, the analysis here will focus on errors in POM and these are seen to arise from the following sources (Gylling et al., 2018):

- Incorrect calculation or registration of weights
- reduction factors
- the presence of free riders (non-registered importers / producers)

As reported by Gylling et al. (2018), years of concerted effort by the Norwegian authorities appears to have brought the free rider problem largely under control, and this is not thought to be a significant influence on measurement of POM.

Therefore, the analysis here will focus on the first two factors. They are regarded separately in the earlier study however they are considered together here. More specifically, incorrect measurements of weights could be manifest in (revised) reduction factors, considered alongside other issues.

### 4.2.1 Analysis of existing reduction factors

Reduction factors are applied to commodity codes to reflect the fact that certain product categories contain both EEE and non-EEE. The Norwegian Environment agency provided the list of old reduction factors covering nearly 800 product types, mapped onto the old product categories. All of the factors are very old, and most are zero. Those that do apply are mostly for products outside the EU scope. However, using supplied data based on POM for 2016 (which should be fine for this purpose, little year-on-year change in the balance of

product supply is expected) we determined weighted average reduction factors across the old product groups with the outcome shown in Table 11.

Then, using the Environment Agency's conversion tool, we mapped the reduction factors from the old product categories onto the new ones, to give reduction factors for the new product categories under the Directive. We determined that there was an effective reduction factor of around 2% for category 5b and around 1% for category 4. Combining these with the most recent POM data revealed that these factors correspond to an effective reduction in POM of around 1.1%, certainly higher than negligible as was assumed in the previous study (Gylling et al., 2018).

Product Group	Average reduction factor	Notes
1-6	0%	No reduction factors for any products in these groups
7	31%	Some products have 50% reduction factors, some products have 0%. A few have factors > 90% but the collected masses are small
8-12	0%	No reduction factors for any products
13	2%	A few low-mass products have factors > 90%, but most relevant reduction factors are 10-20%. Most product types still at 0%.
14	9%	Mostly driven by 25-50% reduction factors in a few product groups

Table 11: Calculated effective reduction factors (based on 2016 data, old product categories)

It seems clear that there is scope for many more reduction factors than are currently in place. A reasonable methodology is required for calculating these, but once such a methodology is in place it seems likely that distance-to-target on the Directive could be reduced. In accordance with the specific requirements for this project, we do not present a full proposed methodology but nonetheless we outline a "roadmap" to revised reduction factors and we support this with some quantified estimates of their likely effect.

#### 4.2.2 Potential new reduction factors

We consider there to be three potential sources of POM reduction, all of which could be embedded in reduction factors:

- 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)
- The effect of gross/net weight declarations and packaging

Identifying **incorrect commodity codes** could increase as well as decrease POM estimates, i.e., could increase or decrease distance-to-target under the Directive. Moreover, this would seem very difficult to discern / evaluate, since in principle all imports and commodity codes are in focus of any investigation. Nonetheless, it is conceivably possible to assemble a list of potentially incorrect commodity codes that could be used for consignments containing EEE, examine a statistically meaningful sample of imports based on those commodity codes, and inspect the details of the consignments to determine if any quantity of EEE is actually present.

Calculating the effect of **EEE and non-EEE across existing commodity codes** is plausible, if onerous. Approaches to calculating existing reduction factors should be reviewed, revised, or extended across the entire range of relevant existing commodity codes. The data supplied by the Norwegian Environment Agency

involved nearly 800 different product groups, with new categories being added each year. However, the mass POM for many of those products was very small and it may be possible to derive a reasonable estimate based on a much smaller number of categories. The approach would be somewhat similar to the above; to first identify relevant commodity codes, to inspect a sample of imports based on those codes, and to consider the balance of EEE and non-EEE across such imports.

The potential **effect of packaging** is much more readily determined than the other sources and may be more significant than previously thought – the Gylling et al. (2018) study suggested that it was thought to be relatively insignificant. Here, an approximate quantitative assessment is attempted, which also shows how a more detailed estimate could be derived. The effect of packaging matters since it is “typical” for gross and net weights to be stated as equal, moreover that gross / net weight declarations are often at the level of whole shipments rather than individual invoices. Nonetheless, it is possible to derive an estimate for the effect of gross/net weight errors due to packaging.

Examining product specifications for different types of electronic products allows an estimate of the packaging weight to be made. (This assumes that “gross weight” and “net weight” as given in such specifications are the weights including and excluding packaging, which is rarely stated explicitly). Nonetheless, a general awareness of electronics and packaging seems to support the data. For the purpose of this analysis, we consider only consumer packaging – that which is in contact with the product and typically accompanies the product to the end-user.

The fraction of gross weight that is packaging is evidently inversely related to the product gross weight – large products such as refrigerators have relatively less packaging and smaller products relatively much more. For a 70 kg refrigerator in product group 1, the packaging might weigh several kilograms (perhaps 5-10% of the net weight). A slightly smaller product, perhaps a large-screen television weighing 20 kg gross (Group 2) might have a similar absolute mass of packaging, this time representing maybe 20-25% of the net weight. For smaller electronic products (for instance a 150g mobile phone) the packaging may well weigh as much or more than the product and represent 50-75% of the net weight. Recognising that there are significant differences within product groups which merit more detailed analysis, we have nonetheless made an average estimate for each of the “new” product categories in the 2019 POM data, as shown in Table 12.

Group	Name	Typical unit gross wt (kg)	Packaging as frac of net wt (estimate)	Approx mass of packaging POM (tonnes)
1	Temperature exchange equipment	70	10%	4000
2	Screens, monitors, and equipment containing screens having a surface greater than 100cm <sup>2</sup>	20	25%	3000
3	Lamps	0.05	5%	100
4	Large equipment > 50 cm	50	10%	7000
5b	Small equipment < 50 cm	5	20%	15000
6	Small IT and telecommunication equipment < 50 cm	2	50%	2500
<b>Weighted average over all product groups (estimate)</b>			<b>15%</b>	

**Table 12: Estimate of packaging for electronics POM across product groups**

The data are weighted by the total reported masses POM and this gives an overall weighted average across the whole range. Consumer packaging accounts for around 15% of the total net weight of EE-POM. Other forms of packaging (distribution or transport packaging) are likely to weigh relatively less than consumer packaging, so are discounted from the analysis although they could also be considered.

In order to derive an effective reduction factor owing to packaging, either for individual product groups or as an across-the-board average, one must also estimate the fraction of imports that are reported with equal gross and net weights – also assuming that the discrepancy is entirely attributable to packaging. We have no data on this at present although it could in principle be investigated via a systematic examination of shipping documentation. It is described as a “typical” problem (Gylling et al., 2018) which leads us to suppose we could estimate a range of perhaps 10-50% of all relevant imports being affected in this way. If 10% of imports are so affected, then POM can possibly be reduced by 1.5% which would effectively reduce the distance-to-target by around 1% (taking waste collected from 53% to 54% of POM). If 50% of imports were so affected, POM could be reduced by 7.5% and Norway’s distance to target would reduce by 4% of POM (waste collected rising from 53% to 57%).

There is clearly merit in a much more detailed study here, although the numbers at present are too crude to be of practical use in terms of revised declarations. Nonetheless, the overall approach to a more detailed analysis looks relatively clear and straightforward, if onerous in terms of data collection and analysis.

The potential effect of batteries in EEE was also noted within the study. Certain types of EEE may be supplied with batteries included, which may be removed and collected separately, hence not appearing in the WEEE statistics. Quantitative data could not be found, in consultation with PROs and recyclers, to derive an estimate of this. It is however noted that the total mass of portable batteries collected in Norway associated with WEEE is relatively low, perhaps around 1000 tonnes per annum.<sup>3</sup> This means that even if all these batteries were “wrongly” excluded from the WEEE statistics, the effect on overall data would be minimal.

## 4.3 Conclusions for WP3

Returning to the research questions for WP3, we can conclude the following.

- a) Reporting and accounting uncertainties probably do contribute significantly to the shortfall in reported WEEE collection rates. Via a very rough analysis we calculate that distance-to-target could reduce by as much as 4% of POM just through the effect of mis-registered consumer packaging. A more rigorous analysis of accounting shortcomings should have a much broader scope, and it is by no means certain that all corrections to accounting and reporting would reduce distance-to-target; it nonetheless seems clear that the current reporting regime understates the WEEE collected overall.
- b) These uncertainties and shortcomings relate both to POM and to WEEE collected figures, with the former probably more significant. Examples of how to modify calculated POM through revised reduction factors are presented above. The likely long-term effect of these is several percent POM, which is higher than the likely effect of issues with WEEE collected data.

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<sup>3</sup> [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste\\_statistics\\_-\\_recycling\\_of\\_batteries\\_and\\_accumulators&stable=0](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_recycling_of_batteries_and_accumulators&stable=0)

- c) Regarding preparation for reuse, consultations with the PROs suggested that the current official figures (where preparation for reuse is very low) probably do capture the effect of preparation for reuse of material already within the compliance scheme. It is clear that much reuse of electronics occurs well upstream of the WEEE value chain. This cannot – and arguably should not – be captured by these statistics. There may be some scope to examine this as part of a revised “waste generated” metric in future, whereby the lifetime of electronics is extended by (upstream) reuse, but the secondary effects on consumer demand and hence POM are also considered.
- d) Certain product groups are probably more affected than others by accounting for (consumer) packaging. Our rough analysis in Table 12 indicates that calculations for products in group 6 are probably most affected in relative terms, and those for products in groups 4 and 5b are most affected both in absolute terms (around 20000 tonnes of consumer packaging is POM per annum for products in 4 and 5b).

## 5 Work Package 4 – Quantifying strengths and weaknesses of the Norwegian supply chains.

This work package aims to capture the positive and the problematic / challenging aspects of Norwegian value chains, considering factors identified in WP1 and WP2. The overall aim of the project is to reduce / minimise the gap between POM (and/or WG) and waste collected. This incorporates the “reuse flows” (those factors relating POM and WG, in particular the customer-retained “hibernating stock”) and the “complementary flows” (the factors relating WG and waste collected - including B2B collection, theft, deposit in residual waste, export and so on).

The main reuse and complementary flows have been identified across the first two work packages. The task in WP4 is to quantify these, to investigate potential improvements and assess their effect, and ultimately to outline a prioritised action plan for reducing these flows and hence move towards compliance with the Directive. Best practice and performance in other countries should inform the recommendations.

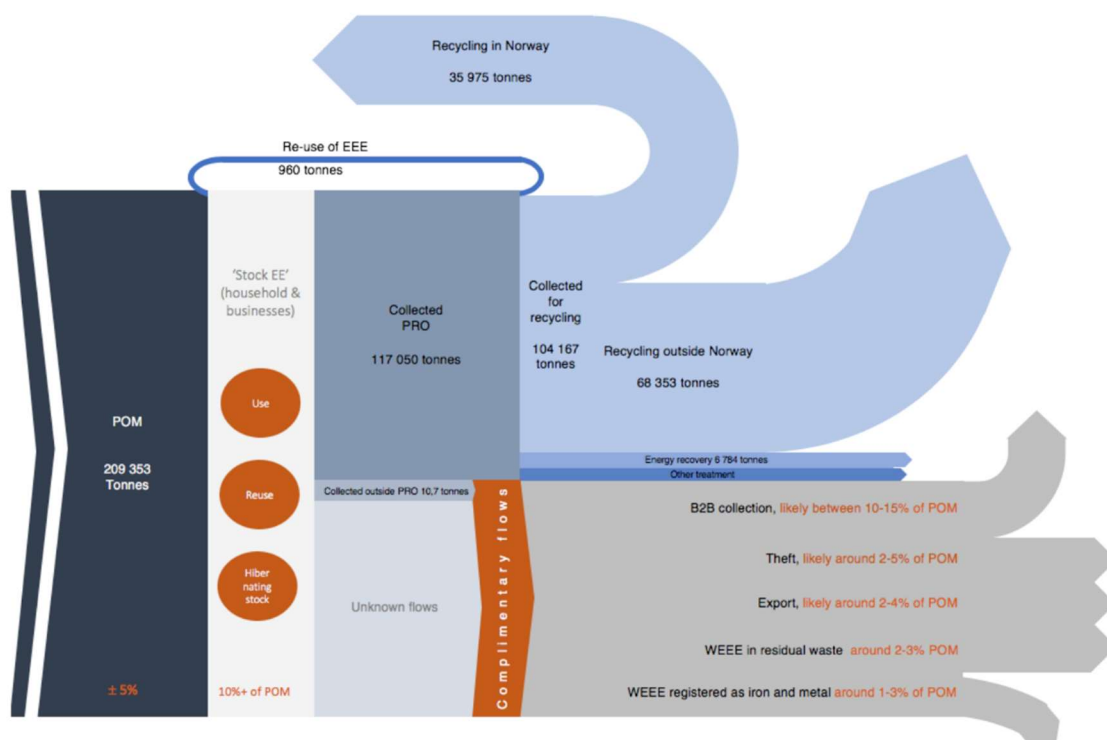
- a) What are the magnitudes of the main reuse and complementary flows in the current Norwegian WEEE value chain?
- b) What are realistic and practicable steps to reduce the magnitude of these flows? What are the biggest, most practically feasible interventions?
- c) What elements of good practice in other countries can be considered?
- d) How do these effects impinge on different product groups?

### 5.1 Status

In 2018 a comprehensive analysis of WEEE flows in Norway was undertaken by this project group (Gylling et al., 2018). The work described and estimated the complementary flows of WEEE from end consumers – WEEE that does not pass through channels authorised by the Norwegian producer responsibility system for WEEE. That report identified the following key flows of WEEE within Norway.

According to the study, complementary flows (flows of WEEE outside producer compliance schemes) account for about 45% of the total amount of WEEE one would anticipate in the waste stream based on the calculated amount POM. Alternative routes for this waste include B2B collection, theft from collection sites, export (legal and illegal), residual waste, and collection as scrap metal. As indicated in the above figure, there is significant uncertainty about the absolute and relative sizes of these flows. Even if one accepts the maximum of the ranges for each complimentary flow, only 30 of the 45% are covered. This means that either one or more of these flows is significantly larger than indicated above, that additional flows exist but are as yet unreported, or that there is a significantly larger growth in stock (used or un-used) than anticipated. More recent work conducted by UNITAR (Baldé et al., 2020b) suggests that unless Norway is a very significant outlier in European terms, significant adjustments to the data in the earlier study may be necessary. In particular, the business-to-business collection looks greatly overstated and the WEEE in metal fractions severely under-estimated. The 2018 report was underpinned by a substantial number of interviews with key stakeholders in the Norwegian WEEE sector: representatives of producer responsibility organisations, actors in the recycling industry, electronics producers (indirectly, being represented by retailers), representatives of municipalities, refurbishers and others. Although a total of 40 interviews was conducted, all in confidentiality, respondents offered only sparse quantitative information on the complementary flows,

thereby only modestly contributing to the establishment of a full overview of the complementary WEEE streams.



This project draws on a handful of interviews, primarily with Norwegian PROs, together with recent international experiences, to complement and build upon the existing knowledge base. Experiences from the Netherlands and the UK have been explored to understand how they address the problems that Norway is currently facing in relation to capturing data on and reporting WEEE flows. The combined findings of this are presented in the following sections.

## 5.2 Complementary flows

Complementary flows represent the difference between POM quantities and the amount of WEEE registered within producer compliance schemes. As described in earlier sections of this report, this is a significant share of the total POM (about 45% of POM in EU scope and a slightly higher proportion outside EU scope). Complementary flows are not necessarily environmentally or socially problematic. A proportion of the WEEE legally collected outside producer compliance schemes may be handled responsibly with valuable materials recovered correctly. However, it is widely accepted that flows outside producer compliance schemes are at greater risk of inappropriate handling and treatment (Baldé et al., 2020b) and certain complementary flows such as theft, illegal export and WEEE in residual waste are indisputably problematic. Also, all of these flows in either category also present a data problem in relation to fulfilment of targets prescribed in the WEEE



Directive. Capturing data on these flows would provide a better indication of Norway's fulfilment of the WEEE Directive target. The main complementary flows are as follows:

- Questionable (may or may not be problematic): B2B collection, legal exports, WEEE in scrap metal
- Problematic: theft, illegal export, WEEE in residual waste

### 5.2.1 Updated knowledge on complementary flows

The following sections provide, where available, updated information on the complementary flows on WEEE. The main sources are anecdotal information from interviews with key stakeholders, and the reports from three studies - the pan-European UNITAR study and country-specific studies in the Netherlands and UK respectively (Baldé et al., 2020b; Baldé et al., 2020a; Sayers et al., 2020). The most general findings from the other more recent studies are as follows:

- B2B collection is generally not classified as a separate complementary flow. Both EEE POM and waste collected are usually classified as either B2B or B2C, but this is an essentially separate exercise from the (complementary) flow accounting. Effectively it is assumed that B2B streams overlap completely with one or more of the other complementary flow pathways.
- Theft is seldom classified as a separate complementary flow, although reference to theft is made with respect to other categories (such as illegal exports).
- Classification of flows varies considerably from country to country, although (nearly) all countries record WEEE in the waste bin (usually residential only), WEEE in metal scrap, and exports as discrete complementary flows.

Following this we will not consider B2B collection as a specific flow, but retain theft as such a flow, since there is specific information in both studies and interviews regarding theft.

#### Theft

According to stakeholders, theft and scavenging of WEEE is still an issue in Norway in 2020. According to some PROs, municipalities have in general improved the issues of fencing and security in an effort to prevent theft and scavenging. However, although many security measures have been put in place at municipal collection points, the increasing number of shops and other retail outlets that offer to take back UEE and WEEE presents a potential issue regarding the broader security of WEEE and UEEE handling. EEE retailers are obliged to accept WEEE of the same product types as the EEE that they put on the market. This makes it very easy for consumers to deliver UEEE and WEEE into the official recycling and waste management system. However, there is reportedly often little security around the return site. Despite this obligation, retailers are points of sale, not waste managers. There is a general likelihood that the ease of access to these return sites, lack of oversight, and lack of incentive to improve oversight, could facilitate significant levels of theft and scavenging.

According to some stakeholders, the requirements for take back schemes can be too open to interpretation and are not being monitored or enforced properly by the authorities. This has consequences both for the amount of theft taking place in this collection route, but also for the efficient reporting of data on the collected WEEE back to the PROs and the authorities. This is one area that needs to be addressed to lower the incidence of theft in the WEEE value chain and increase the quality of data on total collected quantities.

A study in the UK indicated a strong correlation between the price of scrap steel and the incidence of theft of large appliances before they are formally registered in the waste management system (Sayers et al., 2020). Similar dangers seem likely in Norway. The same report also indicates that theft is estimated to account

for approximately 7% of the POM. This is higher than indicated in Gylling et al. (2018) for Norway, which estimated theft as “several percent” of POM. There appears to be more opportunity for theft in the UK for pre-delivery by consumers to recycling centres and also once delivered to the recycling centre. However, the UK does not have the same obligation for retailer takeback, nor the attendant problems with theft from this source. As such, direct comparisons are problematic.

### **Residual waste**

It is anticipated that some quantity of smaller WEEE items still end in residual waste streams. WEEE mixed with household waste can be much more complicated to treat than WEEE in e.g. scrap metal due to contamination. A Dutch study indicates that despite consumer awareness campaigns addressing the correct disposal of WEEE items, bad consumer behaviour still exists: 33 kt of WEEE are still disposed of in the residual waste stream in the Netherlands, accounting for approximately 7% of POM (Baldé et al., 2020a). Further, the report anticipates that this behaviour of the consumer will never be fully eradicated and needs to be recognised when setting the WEEE collection target.

A study in the UK similarly indicates that WEEE continues to appear in residual waste. Again, this primarily involves small WEEE items. In all, it is estimated that 155 kt of small WEEE items end in the household residual waste stream in the UK, representing approximately 9% of the total POM. This calculation comes with a high degree of certainty and overlap between this stream and other WEEE streams is unlikely. As such is likely representative of the actual situation. In addition, it is estimated that a similar quantity of WEEE appears in the residual waste stream from industrial and commercial sources, although this has a significantly higher degree of uncertainty and there is also an understanding that a share of WEEE in this waste stream could be captured within data at a later point in the material flow (hence double-counted)

The amount reported in the Netherlands and the UK are significantly higher in that the 2-3% estimated for Norway in Gylling et al (2018). As such, it may be pertinent to consider the validity of the 2-3% figure. A variety of pluck analyses of residual waste have been conducted in Norway in recent years, covering both household waste and industrial / commercial waste (Bjørnerud, 2019; Hovland, 2017; Larsson, 2018; Lind, 2016; Wærner, 2014; Hovland and Wærner, 2015). On average these indicate that approximately 0,8% of household residual waste is e-waste, and approximately 1,5% of construction and demolition waste is e-waste. Around 900 000 tonnes of household residual waste and around 1.4 million tonnes of construction residual waste are generated each year<sup>4</sup>, meaning that EE-waste constitutes around 7 000 tonnes of household waste and 20 000 tonnes of construction waste. Together this corresponds to about 9% of EE POM (total, both in and out of EU scope). In per capita terms the household residual waste fraction is around 1.5 kg per inhabitant, which is close to the European average (Baldé et al., 2020b).

### **WEEE in scrap metal**

Based on experiences from across the EU, within the product groups under the WEEE directive, it is primarily Large appliances (white goods) that appears in scrap metal waste flows, although there is also a large share of small appliances and temperature exchange equipment. This material can enter the scrap system through either formal (for example, takeback systems or miss-allocation at waste collection points) or informal collection. In the UK, it is estimated that approximately 200kt of WEEE is processed as scrap metal, or approximately 13% of the POM amount. In the Netherlands, it is estimated that over 25% of the total WEEE

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<sup>4</sup> <https://www.ssb.no/en/statbank/table/10514>

generation is handled by 'non-compliant' recyclers – which includes the scrap metal sector but almost certainly also includes other flows considered separately in different studies.

Nonetheless, these figures indicate levels of WEEE in metal scrap significantly higher than the 1-3% of POM estimate for Norway of Gylling et al. (2018). According to some Norwegian stakeholders, the metal scrap in Norway consists primarily of industrial waste, and waste from construction and demolition activities.

It appears that improvements have been made within data sharing and communication between the actors within the industry and the PROs, enabling the capture of more of the material in the official WEEE collection data. Within the last three years, the Norwegian PROs have initiated several projects to increase collaboration. These seek to foster better cooperation on collection and are now seeing improvements in reporting and collection of WEEE. However, the PROs would still like the Norwegian Environment Agency to be more involved in the producer compliance scheme and aid the cooperation, e.g. suggesting ways for movement and initiating new processes.

As noted above in the section on theft, the price of scrap in the UK has a significant incidence on the occurrence of theft of large WEEE appliances before they are registered in the waste management system. The report on UK WEEE management practices and results (Sayers et al., 2020) indicates that the amount of WEEE in scrap is calculated based on a fixed percentage of the scrap waste in recycling facilities, which appears in official WEEE statistics – i.e. a substantiated estimate. According to Norwegian PROs there is a fair amount collected by scrap dealers outside the producer compliance scheme, which is not illegal, but this quantity does not get reported as WEEE. Discussions with the Norwegian Environment Agency (private communication) revealed that the level of WEEE in metal scrap is not directly reported, but that the amounts are likely to be higher than the 2018 report estimates. Numbers from waste handlers indicates that the amount of WEEE could be about 9-10% in this fraction. In principle this number could form the basis of a future substantiated estimate for WEEE in metal scrap. The Environment Agency is also issuing new official statements of appropriate sorting and collection to minimize the mixing of WEEE with the metal fractions. They are further looking into inspection and enforcement activities to improve the routines of waste operators and the sorting practise in waste handling.

## Legal export

There are several avenues for legal export of used EEE that circumvent the existing reporting protocols for WEEE, for example: business-to-business collection and subsequent export to a subsidiary or customer in another market; collection of EEE through retail takeback schemes exported to treatment or sale in third countries inside or outside the EU; cross border internet sale of used EEE.

It is assumed in the concept of using POM that re-use is implicitly included in the calculation – as reused items would, in a steady stock economy, replace new products being put on a market. (That is to say, that re-use within Norway does not need to be directly captured by the statistics, assuming this steady stock model, as reuse directly reduces the POM amount). But where these products are re-used in a third country, and their export is not captured, they fall outside of the existing calculation method.

It has not been possible to significantly build on the estimates included in Gylling et al. (2018) for the quantities of WEEE being exported. That report estimated up to 5% of EEE POM being exported in one form or another. The report on WEEE in the Netherlands indicates that around 7% of EEE POM is exported for reuse, while in the UK report, this was around 3% for legal and illegal exports combined. It is important to

note that there is a potential for double counting between B2B collected and export quantities, as it is anticipated that a portion of the B2B collected WEEE is exported.

### **Illegal export**

According to stakeholders there has been a recent change in the export/shipping of WEEE to Africa. After a Norwegian documentary in the autumn of 2020 showed the export of WEEE from Norway to Africa, authorities have made a series of efforts to reduce this flow. This has primarily been implemented through a greater focus on the issue at customs authorities and information and communication material to freight and shipping companies, which is foreseen will result in a decrease in the shipment to Africa, which in turn should be reflected in the statistics in coming years. All contacted stakeholders have experienced the increased focus on the issue, and a tender from the environmental ministry of cooperation between customs, MD and other agencies has been put in place to identify ways of minimising the illegal export.

The quantities involved do, however, appear to relatively small fractions of POM. In addition, although recognizing and appreciating the changed behaviour since the documentary, some of the behaviour changes and focus on the issue appear to be decreasing recently. As such, some PRO's highlight the importance of the environmental authorities following up on the initiatives.

### **5.2.2 Conclusions**

The earlier estimates of theft levels are possibly a little low, particularly with the concerns expressed about the security of some retail takeback sites. However, the 7% POM estimate for the UK would seem to be an over-estimate for Norway. WEEE in metal scrap possibly constitutes 10% of POM or more. Earlier estimates of WEEE in residual waste are almost certainly too low, the pluck analyses seem reasonably clear and hint at levels of WEEE in the domestic residual waste around the European average (up to 10% POM). The WEEE in waste from commercial and industrial sources is harder to gauge but an outcome like the UK figures suggesting a further 10% of EE-POM in waste from commercial / industrial figures would not be unexpected. WEEE in exports is similarly difficult to classify but an estimate of 3-5% of POM seems reasonable given theft is identified as a separate flow. With B2B collection removed as a separate flow, this leaves perhaps 10% POM in the "unknown" category of complementary flows, which is fairly typical for studies across Europe as a whole (Baldé et al., 2020b). The Dutch and British studies each present total figures without uncertainty identified as such, but the generality of some of the categories in the analyses definitely conceals significant uncertainty.

## **5.3 Reducing the magnitude of complementary flows**

This section provides insight gained from the stakeholder interviews and from the two international reports on WEEE flows.

### **Minimising theft from retail takeback sites**

Reducing the implied incidence of theft from retail takeback sites is regarded by those interviewed as a key factor in closing a current leakage point. Although it has not been possible to accurately gauge the scale of theft from these sites, there was a consensus that it represents a significant problem. There appears to be little incentive for retailers to improve security around the collection facilities. It is also difficult to assess how this leakage takes place in practice: opportunistic theft, planned and/or organised theft, employee theft. It is also difficult to know from current knowledge base whether the loss of material from the collection point

is considered by the actors involved (the retailers as well as the people taking items) as ‘theft’, or whether than collection points are seen as a resource to be exploited. Some interviewees have experienced large rises in collection rates (up to 20%) from larger retail collection points following initiatives such as better alarm systems, restriction on night-time deliveries and closer supervision of sites during opening hours. However, recent improvements might also be linked to conditions under Covid-19, such as limitations on movement across borders, inhibiting some of the normal pathways for stolen WEEE.

### **Reducing WEEE in residual waste streams**

WEEE in (domestic) residual waste appears to be a more significant problem than the 2018 study indicated, in excess of 5% POM, but nonetheless reasonably typical on a pan-European per capita basis. Nonetheless, neither the specific studies, nor our interviewees, nor literature sources appear to give much by way of specific suggestions for reducing WEEE in residual waste, beyond the somewhat obvious “developing communication with consumers to raise awareness” or similar.

### **Reducing WEEE in metal scrap**

Both the literature sources and recent Norwegian investigations by the Environment Agency (private communication) suggest relatively high levels of WEEE in scrap. In many cases such WEEE is handled appropriately, and the issue is one of accounting (capturing WEEE in scrap within the domain of the Directive). Certification of actors outside producer compliance schemes offers one route to this. In the Netherlands, WEEELABEX certification has been mandatory by law since July 2015, and the present registration of WEEE collection data in the National WEEE Register (NWR) is therefore based exclusively on WEEE treated in compliance with WEEELABEX. 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) (Baldé et al., 2020a) However, the WEEE mixed with metal scrap, or managed by non-compliant metal scrap dealers, could not be directly quantified in 2018.

This indicates that there is a delicate balance between engaging the market in officially recognised, voluntary agreements, and pushing some otherwise semi-transparent flows into a situation where they are essentially invisible. Furthermore, the Norwegian authorities are cautious about initiating any new national standards before the EC has agreed on European minimum standards. As a first step the Norwegian Environment Agency has recently issued statements on appropriate sorting and collection which can be used as information material by the PROs and a next step must be to further quantify the amount of WEEE in scrap markets, assess how much of this material is already captured by existing reporting mechanisms, and devise a means by which the remaining quantity can be captured legitimately, without forcing it further into illegitimate material streams. Based on the above experience, engagement with the scrap industry and the avoidance of imposing sanctions appears to be a good first step.

### **Capturing Legal Export**

Legal export of WEEE and UEEE is a challenge for the current WEEE reporting system. However, in taking steps to address the above flows, most of this flow should be captured. WEEE and UEEE is not exported by consumers, but by industries that have captured WEEE and UEEE from consumers, businesses and public organisations. By working with key exporters to capture data on the flows within B2B collection it could be possible to significantly improve data on the flow of WEEE out of Norway.

## 6 Conclusions

The most important conclusions of this work stem from the balance between the subjects of Work Packages 3 and 4 – namely uncertainties or inaccuracies in data, as opposed to complementary flows. Reduction of distance-to-target (DtT) under the Directive, and moving Norway closer to compliance, probably requires elements of both.

It seems clear that in terms of immediate DtT reduction, the activities outlined in Work Package 3 such as assessing the effect of packaging and misrepresentation of products on POM are the most promising. Rough calculations indicate that examination of reduction factors and related work could reduce DtT by perhaps 5% of EE-POM under current conditions. This would be a substantial improvement, representing around half of Norway's total shortcoming with respect to the Directive, which currently stands at around 11% of EE-POM. Capturing non-EEE registered as EEE has the potential to reduce DtT even further, although it should be noted that the reverse (hence widening DtT) would also be possible within investigations of mis-registered (W)EEE.

Furthermore, such moves on their own would seemingly prove insufficient to bring about compliance. Perhaps more importantly, it can be argued that such moves would not deliver any real-world improvements in the value chain; improvements in reporting do not constitute real environmental savings or increased circularity / sustainability. Achieving this (and, it seems, moving close to compliance) may only be possible by addressing the complementary flows directly.

The actors consulted in the course of this project were almost universally pessimistic about the state of the sector with respect to complementary flows and the reduction thereof. They consider that the system generally works reasonably well and that there is limited scope for further improvement as the system currently stands. The environmental authorities have suggested some practical shortcomings in limiting "leakage" of WEEE from the system, in turn the producers have called for more rigorous enforcement of the existing rules, particularly for actors outside the producer compliance scheme. However, an impartial perspective on both issues suggests that whatever might be theoretically achievable in principle (reduction of leakage, enforcement) is extremely difficult in practice.

The conclusion is that some variation of the All Actors Approach (AAA) proposed by the PROs is the most promising route to real-world improvements in sustainability via increased collection and quality of handling in practice. The AAA, or at least some significant reframing of the regulatory framework, looks essential as a pre-requisite for change. There seems very limited scope in improving things essentially as they are.

Despite the denials of the producers (WEEE Forum, 2020), such a move *does* represent a significant departure from the principle of Extended Producer Responsibility – which (as originally and currently conceived) *does* imply, more or less, "exclusive producer responsibility". Attempts to effectively downplay any prospective move to AAA are inappropriate – it represents a fundamental change in the WEEE value chain. However, the peculiar feature of the waste having a positive value for actors outside the system perhaps means that EPR as originally constituted is not completely fit for the purpose of WEEE.

The study recommends that the relevant Norwegian bodies are convened to develop a roadmap towards AAA and in the interim considers a detailed study on reduction factors, packaging and other elements leading to misrepresentation of EE-POM, so as to (probably) reduce Norway's distance-to-target under the Directive as it currently stands.



## References

- BALDÉ, C., VAN DEN BRINK, S., FORTI, V., VAN DER SCHALK, A. & HOPSTAKEN, F. 2020a. The Dutch WEEE Flows 2020, What happened between 2010 and 2018, 2020,. Bonn, Germany: United Nations University (UNU) / United Nations Institute for Training and Research (UNITAR) - co-hosted SCYCLE Programme.
- BALDÉ, C., WAGNER, M., IATTONI, G. & KUEHR, R. 2020b. In-depth review of the WEEE Directive minimum collection rates in the EU-28, Norway, Switzerland, and Iceland. Bonn, Germany: United Nations University (UNU) / United Nations Institute for Training and Research (UNITAR) - co-hosted SCYCLE Programme.
- BJØRNERUD, S. 2019. *Analyse av restavfall og grønne poser, detaljert plastanalyse og posebrekkasjeanalyse ROAF* [Online]. Available: <https://www.roaf.no/wp-content/uploads/2019/05/ROAF-rapport-plukkanlyse-2019.pdf> [Accessed].
- EUROPEAN ELECTRONICS RECYCLERS ASSOCIATION 2019. Opposing policies of the WEEE Directive (2012/19/EU) undermine growth in the proper treatment of WEEE in Europe.
- EUROSTAT. 2020. *Waste electrical and electronic equipment (WEEE) by waste management operations [env\_waselee]* [Online]. Available: [https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env\\_waselee&lang=en](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_waselee&lang=en) [Accessed September 2020].
- GYLLING, A., BAUER, B., EGEBAEK, K. R., BAXTER, J. & PRESTRUD, K. 2018. The Norwegian WEEE Flows. The Norwegian Environment Agency.
- HOVLAND, K. 2017. *En analyse av husholdningsavfallet fra henteordningens avfallsbeholdere i Oslo kommune. Hjellnes Consult for Renovasjonsetaten* [Online]. Available: <https://avfallnorge.ams3.digitaloceanspaces.com/avfall-norge-no/dokumenter/Avfallsanalyse-Oslo-2017-Hovedanalyse-husholdningsavfall.pdf?mtime=20180315142441&focal=none> [Accessed].
- HOVLAND, K. & WÆRNER, E. R. 2015. *Plukkanalyser av restavfallskontainere fra byggeplasser: Innspill til NHP-nettverket* [Online]. Available: <https://www.byggemiljo.no/wp-content/uploads/2017/03/Plukkanalyser-p%C3%A5-restavfallskontainere-fra-byggeplass.pdf> [Accessed].
- LARSSON, B. 2018. *Plukkanalyse av avfall fra Karlsøy og Tromsø* [Online]. Available: [https://www.remiks.no/wp-content/uploads/2019/12/remiks\\_envir\\_plukkanalyse\\_2018.pdf](https://www.remiks.no/wp-content/uploads/2019/12/remiks_envir_plukkanalyse_2018.pdf) [Accessed].
- LIND, C. 2016. *Restavfall Hessa og Flisnes, 2016* [Online]. Available: <https://avfallnorge.no/fagomraader-og-faggrupper/plukkanalyser/restavfall-hessa-og-flisnes-2016> [Accessed].
- LINDHQVIST, T. & LIDGREN, K. 1992. Towards an Extended Producer Responsibility-analysis of experiences and proposals. *Ministry of the Environment and Natural Resources, Stockholm*.
- SAYERS, M., SILVA, C., SCHAEER, O., STOWELL, A., YUMASHEV, D., DOWNES, S., GRANTHAM, L., LAUNDON, C. & MCCOACH, H. 2020. Electrical Waste-challenges and opportunities: An Independent study on Waste Electrical and Electronic Equipment (WEEE) flows in the UK.
- WÆRNER, E. R. 2014. *Økt sortering av rene fraksjoner av byggavfall: Innspill til NHP-nettverket* [Online]. Available: [https://www.byggemiljo.no/wp-content/uploads/2014/10/79\\_Okt-materialgjenvinning.pdf](https://www.byggemiljo.no/wp-content/uploads/2014/10/79_Okt-materialgjenvinning.pdf) [Accessed].
- WEEE FORUM. 2020. *An enhanced definition of EPR and the role of all actors* [Online]. Brussels. Available: [https://weee-forum.org/wp-content/uploads/2020/11/EPR-and-the-role-of-all-actors\\_final.pdf](https://weee-forum.org/wp-content/uploads/2020/11/EPR-and-the-role-of-all-actors_final.pdf) [Accessed].



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