WEEE: WHERE DID IT GO?

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ALTROCONSUMO | Erion Weee

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1. The aim of the investigation

Where does WEEE, Waste Electrical and Electronic Equipment, end up once it leaves the homes of Italians? WEEE is all those equipment and devices needing electric currents to function properly – such as refrigerators, washing machines, smartphones, vacuum cleaners but also light bulbs, tablets, PC mouses, headphones, etc. – and that we decide to throw away once they become obsolete or break.

WEEE, unlike other types of waste such as paper, cardboard and glass, is often not disposed of properly. It is forgotten in closets, stashed in garages or attics or, in the worst cases, thrown in the bin for the plastic or in the garbage can. Yet, if properly recycled, WEEE represents a key resource for our future and that of the Planet. Italy has made giant strides in the collection and treatment of WEEE; however, a still rather high percentage of e-waste escapes the formal recycling System and is dispersed in untracked and sometimes not even legal flows, causing damage to the economy and the environment.

Last year in Italy more than 360,000 tonnes of WEEE were collected through the Collective Systems of the official network, with a drop, after 8 years of growth, of 6.2% compared to 2021. The per capita figure for Household WEEE in Italy now stands at 6.12 kg per inhabitant[1]. In order to reach the targets, set at European level, Italy would have to almost double its collection rate to about 11 kg per inhabitant. More than 400,000 tonnes of Household WEEE are unaccounted for, i.e. almost 3 million large appliances (such as refrigerators, air conditioners and washing machines) and more than 400 million small appliances and devices (such as mobile phones, microwaves, radios). A loss that has major repercussions at a national level, even more so at a time of serious lack of resources such as the present. The European Union has in fact set ambitious collection targets, so as to ensure that WEEE that leaves our homes is treated in an environmentally sound manner, thereby enabling the recycling of the materials of which it is composed.

Copper, iron, aluminium, glass, plastic are the main fractions that can be obtained from WEEE and which can be used for the production of new equipment and appliances, avoiding the use of virgin raw materials and, consequently, their extraction. The proper recovery and recycling of WEEE contributes to the transition towards the Circular Economy, providing Secondary Raw Materials and Critical Raw Materials essential for many strategic sectors, from renewable energy to electric mobility.

Last March, the European Commission released the most up-to-date list of Critical Raw Materials (CRMs), which includes 34 elements (4 more than in 2020): among these, 17 resources have been deemed strategic by the Commission, which considers them "*important for technologies that support the twin green and digital transition and defence and aerospace objectives*". Furthermore, with the drafting of the Critical Raw Materials Act of 16 March 2023, the Commission has introduced precise objectives to strengthen the different value chains throughout the European Union[2]. European countries, which have limited availability of Critical Raw Materials, can become less dependent on third countries for their supply if they invest significantly in domestic production of CRMs and are able to obtain a greater contribution from the collection and subsequent recycling of WEEE.

[1] The figures refer to data of the 2022 Annual Report of the Centro di Coordinamento RAEE.
[2] Further insights on the Critical Raw Materials Act are available on the European Commission website.

In detail, the EU-wide targets are:

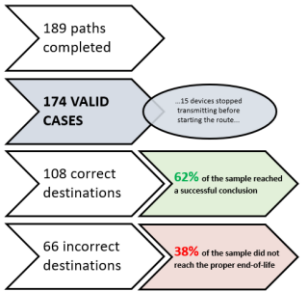
- **10%** of CRMs consumption must come from extraction (the EU today extracts about 3% of them, with a value close to 0% for rare earths);
- **40%** of consumption from refining (the EU today refines on average 10% of them, with a value close to 0% for rare earths);
- **15% of CRMs consumption from recycling** (today in the EU for 26 out of 34 CRMs, recycling accounts for less than 10% of total demand, with a value of 1% for rare earths);
- **no more than 65% of the supply of each CRM has to come from a single country**, in a context where – at present – 10 out of 34 CRMs surveyed by the EU show a global concentration well above 65%: Beryllium, 88% supplied from the USA; Bismuth, Germanium, Gallium, Magnesium, Phosphorus, Silicon, 70%, 83%, 94%, 91%, 74% and 76% supplied by China; Cobalt, 67% supplied by the Democratic Republic of Congo; Niobium, 92% supplied by Brazil; Platinum, 71% supplied by South Africa.

Due to the risks associated with the current concentration of production in third countries, the European Union needs to diversify its supply, making it secure and resilient, ensuring the monitoring of supply chains and developing national research and innovation programmes. In particular, one of the solutions to the issue of potential problems in the sourcing of CRMs is the proper collection of WEEE, which contains many of these materials. It is important to highlight that the collection rate is even lower for WEEE containing a larger amount of CRMs, i.e. small electronic equipment (tablets, laptops, mobile phones). In general, the failure to properly manage WEEE by operators in the formal System is a major concern both for the environmental impacts of incorrect treatment and for the non-recovery of most of the CRMs present in it.

So where do these hundreds of thousands of tonnes of e-waste that represent a valuable source of raw materials end up? How could we try to limit their dispersion?

To shed some light on the subject, in 2019[3] we conducted a monitoring investigation with the aim of identifying which are the main parallel streams in which WEEE is dispersed when it does not arrive at approved authorised WEEE treatment facilities, and which are the critical steps in the WEEE collection mechanisms where action needs to be taken to improve results.

To do so, the routes of some 200 large appliances from citizens' homes to Collection Centres and then to treatment facilities had been followed.



Summary of the results of the investigation as at 30 September 2019

[3] An investigation on 200 large WEEE was carried out in 2019 and is available at http://www.altroconsumo.it/

The results of this investigation showed the existence of unofficial management circuits and a lack of controls along the whole chain. In particular, WEEE managed by not approved authorised WEEE treatment facilities to the WEEE Clearing House or even not registered with this body, e-waste that ended up back in private households without having undergone any preparation for re-use, and therefore without any guarantee of safety for those using it.

Has anything changed since then? To answer this question, Altroconsumo and Erion WEEE decided to carry out a second investigation, this time tracking 370 WEEE.

In 2023, each of these old or broken appliances and equipment was fitted with a GPS device capable of tracking its location all the way from the home where it was located.

Unlike the last investigation, this one was extended to include small devices such as smartphones, tablets, Bluetooth speakers, etc. in order to check the informal flows in a category with the lowest collection rates. Last year, Grouping R4 decreased by 7.5% compared to 2021, with a collection volume of 71,494 tonnes.

2. The WEEE System

In order to understand the results of the investigation, it is appropriate to first provide some information on WEEE and its proper management.

The 'formal' management System for WEEE from private households is made up of multiple Collective Schemes. Regulated by Legislative Decree 49/2014, it is based on the responsible action of the different actors involved: Producers of Electrical and Electronic Equipment, retailers and installers, municipalities and waste collection companies, citizens, approved authorised WEEE treatment facilities by the Centro di Coordinamento RAEE (CdCRAEE). Within this system, the Centro di Coordinamento RAEE is the reference point for the activities of all actors involved. Producers of EEE fulfil their regulatory obligation by establishing Collective Systems, i.e. non-profit Collective Schemes which are parties to the Centro Di Coordinamento RAEE and provide for the pick-up of WEEE from Collecting Points and transport it to qualified treatment facilities for its recovery under uniform operating conditions throughout the national territory. Responsibility for the collection of e-waste delivered free of charge by citizens is assigned by law to municipalities – which set up Collection Centres managed autonomously or entrusted to waste collection companies – and to EEE retailers (Ministerial Decree 65/2010 and Ministerial Decree 121/2016) who organise their own Grouping Places or deliver WEEE to the affiliated municipal Collection Centres.

WEEE collection is regulated and organised according to the following five Groupings:

R1 Cooling and A/C equipment: refrigerators, freezers, air conditioners, dryers, etc.;

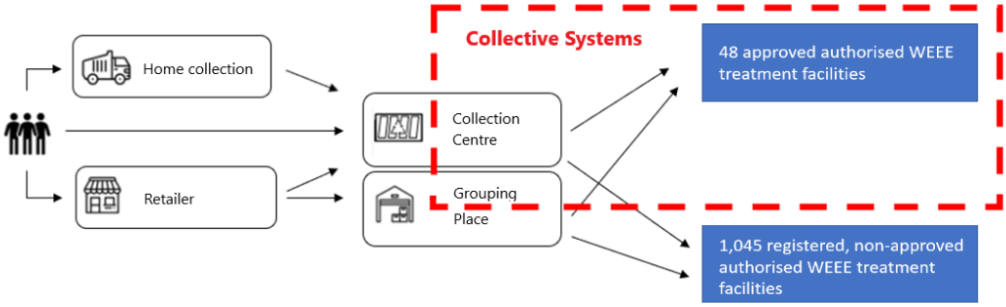
R2 Large white goods: washing machines, dishwashers, ovens, etc.;

R3 Devices with screens: TV sets and flat screens, TV sets and cathode ray tubes, tablets, digital picture frames, etc.;

R4 Small household appliances and consumer electronics: small appliances, electronic or digital equipment, lightning equipment, PV panels, etc.;

R5 Light sources: discharge lamps, fluorescent lamps, neon tubes, LED bulbs, etc.

The scheme provided by law (Legislative Decree 49/2014) for the disposal, transport and treatment of Household WEEE is as follows:



The methods available to citizens to properly dispose of their WEEE and ensure its recycling are as follows:

- delivery of WEEE directly to their municipal **Collection Centres** (or home collection by the urban hygiene company, where foreseen, especially for heavy and bulky WEEE);
- **One-to-One:** return of WEEE of any size to any retailer of Electrical and Electronic Equipment against the purchase of an equivalent product;
- **One-to-Zero:** return of small WEEE (with a maximum size of less than 25 cm) to retailers of Electrical and Electronic Equipment with a sales area of at least 400 square metres with no obligation to buy.

For those who collect WEEE (local authorities, urban hygiene companies, retailers of Electrical and Electronic Equipment), current regulations allow them to 'hand over' WEEE either to Collective Schemes (such as Erion WEEE) or to any facility who have been issued an authorisation for the treatment of this waste: currently at the Centro di Coordinamento RAEE, the body that coordinates the management of WEEE by Collective Systems to ensure uniform coverage across the whole national territory, there are 48 'approved authorised' and 1,045 'registered' WEEE treatment facilities.

'Approved authorised' WEEE treatment facilities have successfully passed the checks on the quality of the treatment processes defined in the Programme Agreement on the adequate treatment of WEEE signed between the parties: the Collective Systems are obliged to use only 'approved authorised' WEEE treatment facilities, in which they obtain Secondary Raw Materials to be reintroduced into new production processes and is ensured the proper management of hazardous and environmentally critical fractions.

'Registered' WEEE treatment facilities have not, however, deem it appropriate to undergo quality checks on their treatment processes and cannot therefore receive WEEE from the Collective Systems, but nothing prevents them from taking WEEE directly from the entities carrying out the collection.

In 2022, the 1,045 'registered' WEEE treatment facilities declared only 4% of the total amount of Household WEEE treated, while 96% was declared by the 48 'approved authorised' WEEE treatment facilities.

3. Investigation methodology

3.1. WEEE monitored and starting points

A total of 370 WEEE were used for the investigation, of which 300 were large appliances and 70 small appliances.

End-of-life appliances were identified through citizen involvement by Altroconsumo through its **ACmakers** virtual community (https://acmakers.altroconsumo.it/). A social platform, to which tens of thousands of people, both Altroconsumo members and non-members, are registered, where people take part in product tests, investigations on various topics and multiple activities, earning points in return or receiving prizes and gift vouchers. Would-be investigation participants were invited to fill in a questionnaire with their personal data and information on the appliance to be disposed of. Altroconsumo selected voluntary participants on the basis of the type of household appliance and their geographical location. To give greater solidity to the investigation and be able to have a complete overview at national level, the sample had to have a good territorial coverage from North to South, including the Islands, and cases from metropolises, large cities and smaller municipalities.

Below, the e-waste examined for the investigation:

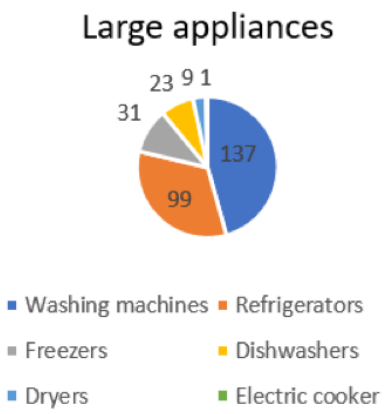
300 large appliances:

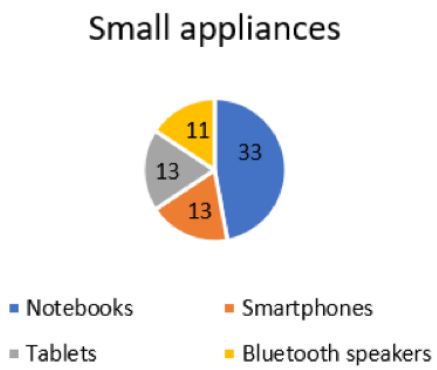
- 137 washing machines
- 99 refrigerators
- 31 freezers
- 23 dishwashers
- 9 dryers
- 1 electric cooker

all free-standing and not built-in

70 small appliances:

- 33 notebooks
- 13 smartphones
- 13 tablets
- 11 Bluetooth speakers





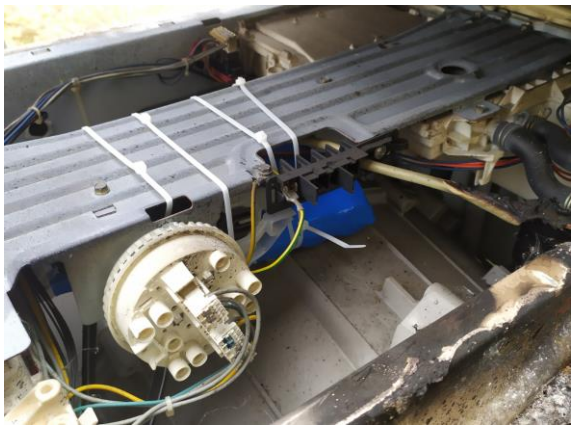
A battery-powered GPS tracker was installed on each WEEE leaving the volunteers' homes in order to verify the location of the WEEE in real time.

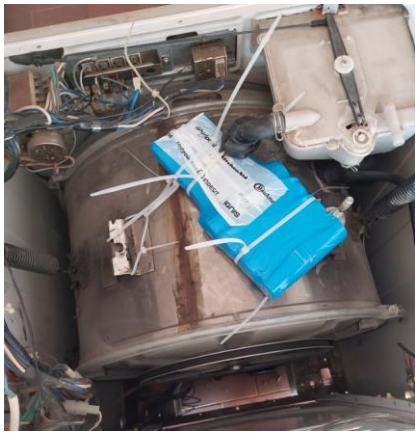
Participants were given complete freedom to choose their preferred disposal method, being able to opt for direct delivery to a Collection Centre, home collection by the urban hygiene company or retailer (One-to-One), delivery to the store in "One-to-One" or in "One-to-Zero" basis.

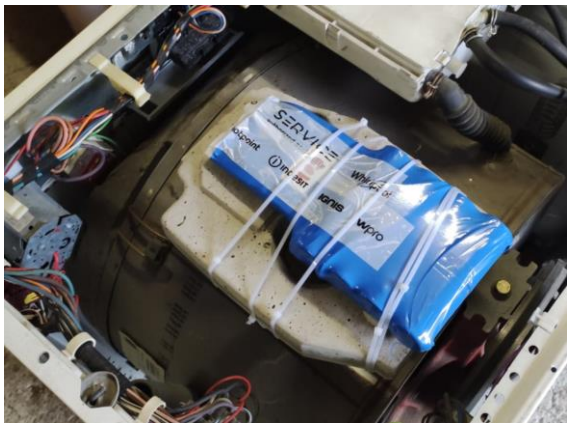
3.2. Tracking systems

The tracking systems were chosen according to the size of the WEEE, so as to be hardly visible to the collection and facility operators. Each GPS trackers was associated with a reference WEEE through an identification code previously linked with the volunteer owner of the waste and participant in the investigation.

In the case of large appliances, it was possible to use medium-sized transmitters (28 x 13 x 4 cm) since made invisible by their installation inside the appliance. The installation was carried out by personnel specialised in the technical assistance and repair of electronic equipment (TACs, Technical Assistance Centres) to whom Altroconsumo communicated the names of the volunteers. The TACs arranged with the volunteers the date and time of the appointment for the installation at their homes. For large appliances the GPS trackers were installed inside the WEEE: for R1s, they were fixed to the back panel, near the appliance's motor; for R2s, the tracking devices were housed inside the machine under the cover.







For WEEE belonging to Groupings R3 and R4, two different, smaller trackers were used, which were sent directly to the volunteers' homes together with instructions on how to position them on their electronic waste. The trackers were placed so as not to be immediately visible, in a position suitable for signal transmission.

For notebooks and Bluetooth speakers, the chosen tracker had dimensions of 14 x 7 x 2 cm.

For smartphones and tablets, the chosen tracker had dimensions of 11 x 3 x 1 cm.

Due to the small size, the battery life of the trackers used on small WEEE was much shorter than that of the trackers used on large WEEE. In order to prolong their lifetime, the trackers were programmed in such a way that their position update frequency was not too high, resulting in a small decrease in location accuracy.

With regard to the transmission of the GPS signal, it was necessary for the tracker to be able to simultaneously connect both to the satellite network to detect its position and to the mobile network to send this position to the related platforms. When the tracker's reception was shielded, e.g. in the case of transport in a steel-plated truck, or when the tracker was buried under cubic metres of other metal materials, the signal transmission was compromised, showing on the platform the last detected position and not the current one.

Once completed the disposal phase of their WEEE, the volunteers were asked to fill in a second end-of-activity questionnaire to provide us with information about the disposed WEEE, the date and time when the tracker was installed, and the method, place and time of disposal in order to have all the information necessary to start analysing its route.

3.3. Routes analysis

The three different types of trackers used were each connected to their own monitoring platform. These platforms allowed similar monitoring for the different types of WEEE, although they differed in the way they could be consulted: the platform used for smartphones and tablets worked via an app installed on a smartphone, while those used for other devices worked via a web platform.

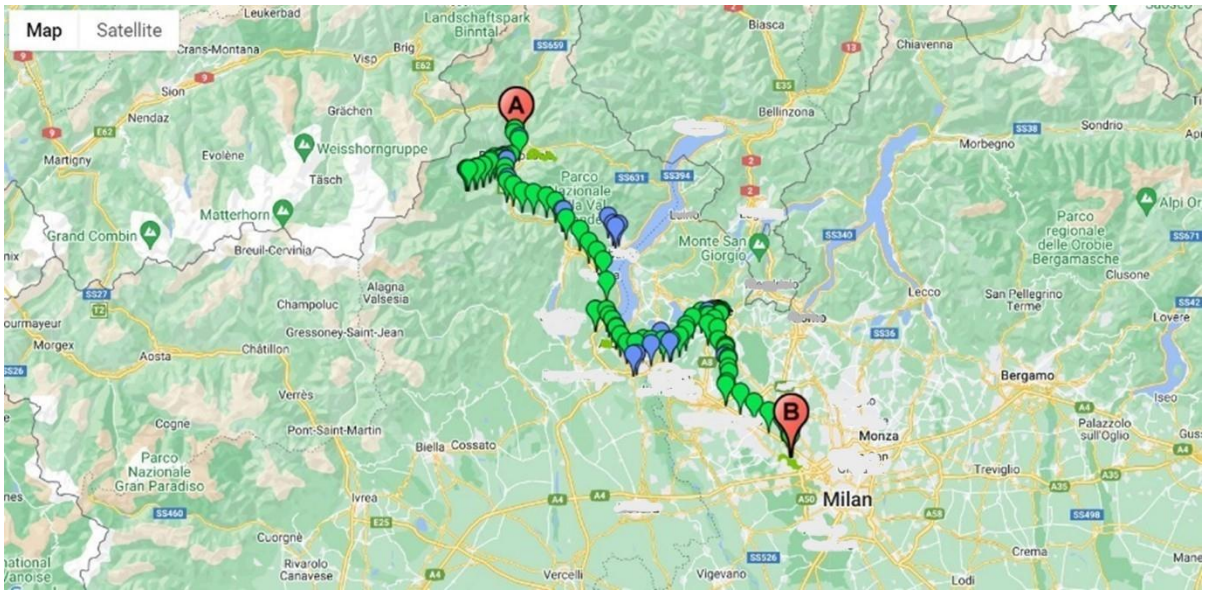


Figure 1: Example of a map of routes recorded via web application used for large appliances.

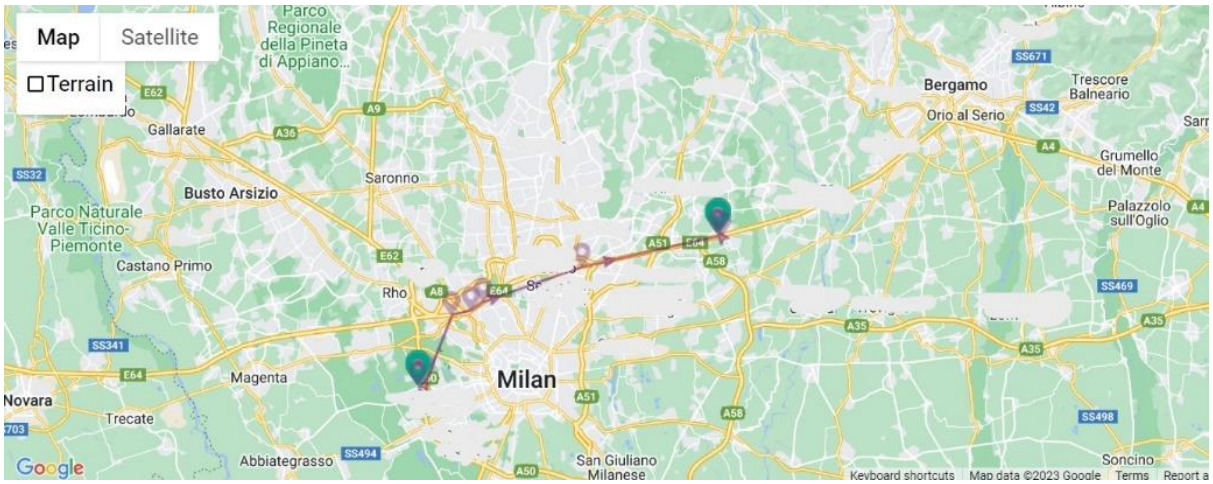


Figure 2: Example of a map of routes recorded via web application used for notebooks and Bluetooth speakers.

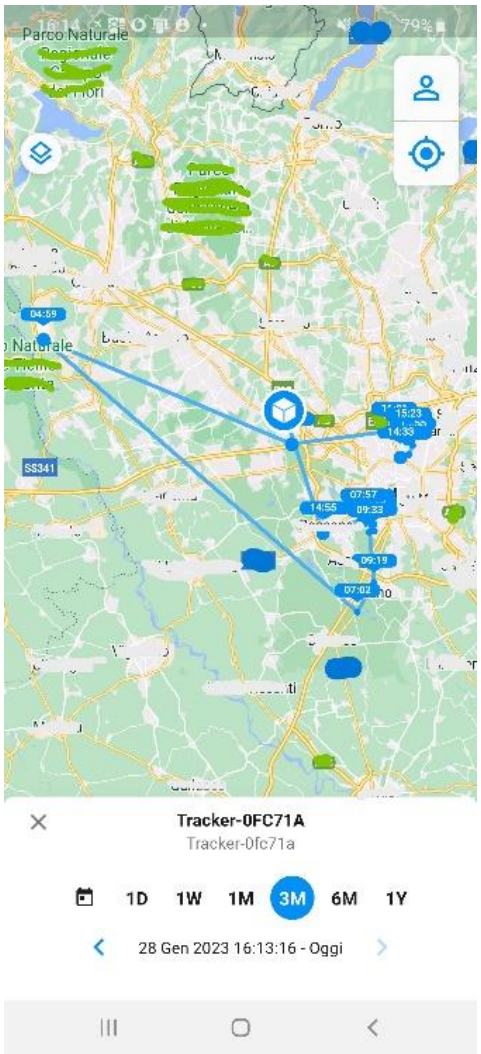


Figure 3: Example of a map of routes recorded via smartphone app used for smartphones and tablets.

With all platforms it was possible to track the movements on the maps – thanks to the placemarks created for each detected position, to which the geographical coordinates and date/time of the detection were associated, as well as a timely verification on the map for each individual detected position. The example below shows a considerable number of detections at the skips of a Collection Centre.

Figure 4: Example of timely verification on a map of detected positions.

These positions along the route, as well as being displayed directly within the interface, were downloaded in Excel files, such as the one shown in the following image.

Giorno aggiornamento	Ora aggiornamento	Ultima posizione (coordinate)	Ultima posizione (indirizzo)
5/4/2023	09:54:38	41.747244-14.481257	[redacted]
5/4/2023	09:51:39	41.774830-14.500735	[redacted]
5/4/2023	09:48:41	41.790492-14.535628	[redacted]
5/4/2023	09:45:42	41.809307-14.568020	[redacted], Italy
5/4/2023	09:42:43	41.838556-14.581870	[redacted] Italy
5/4/2023	09:39:44	41.850379-14.600127	[redacted] Italy
5/4/2023	09:36:46	41.874156-14.603580	[redacted] Italy
5/4/2023	09:33:47	41.894751-14.618287	[redacted] Italy
5/4/2023	09:30:48	41.897452-14.630750	[redacted]
5/4/2023	09:27:52	41.918525-14.661690	[redacted]
5/4/2023	09:08:10	41.918821-14.661905	[redacted]
5/4/2023	09:05:11	41.918803-14.661877	[redacted]
5/4/2023	09:02:13	41.944175-14.663823	[redacted], Italy
5/4/2023	08:59:14	41.971602-14.693313	[redacted]
5/4/2023	08:56:15	42.002304-14.719567	[redacted]
5/4/2023	08:53:17	42.030096-14.743768	[redacted]
5/4/2023	08:50:18	42.044060-14.753160	[redacted]
5/4/2023	08:47:20	42.044722-14.752183	[redacted]
5/4/2023	08:21:37	42.044763-14.752223	[redacted]
5/4/2023	08:18:39	42.044776-14.752203	[redacted]
5/4/2023	08:15:40	42.037392-14.747125	[redacted]
5/4/2023	08:12:41	42.047838-14.761948	[redacted]
5/4/2023	08:09:42	42.072987-14.759112	[redacted]
5/4/2023	08:06:45	42.089332-14.731512	[redacted]
5/4/2023	08:00:12	42.090376-14.729997	[redacted]
5/4/2023	07:57:13	42.094187-14.724485	[redacted]
5/4/2023	07:54:14	42.107384-14.716038	[redacted]
5/4/2023	07:51:15	42.137343-14.716967	[redacted]
5/4/2023	07:48:17	42.165032-14.703177	[redacted]
5/4/2023	07:45:18	42.164984-14.668107	[redacted]
5/4/2023	07:42:19	42.163911-14.642710	[redacted]
5/4/2023	07:39:21	42.184168-14.634558	[redacted]
5/4/2023	07:36:22	42.200005-14.613027	[redacted]
5/4/2023	07:33:23	42.211098-14.589143	[redacted]
5/4/2023	07:30:25	42.225917-14.556855	[redacted]
5/4/2023	07:27:26	42.242251-14.521132	[redacted]
5/4/2023	07:24:27	42.214150-14.494417	[redacted]
5/4/2023	07:21:29	42.197914-14.478610	[redacted]
5/4/2023	07:18:30	42.167369-14.449463	[redacted]
5/4/2023	07:15:31	42.138338-14.427815	[redacted]
5/4/2023	07:12:32	42.122997-14.431845	[redacted]
5/4/2023	07:09:34	42.103928-14.434172	[redacted]

Figure 5: Example of table with dates, times and geographical coordinates of detected positions.

To verify the route and stopping points, the tools used were both the positions printouts and the maps and images of the places and facilities available on Google Maps.

The stopping points along the route were examined and compared with the addresses of the WEEE

treatment facilities registered or approved authorised to the Centro di Coordinamento RAEE, the Collection Centres and the Grouping Places, provided by Erion. Each significant stopping point for the purposes of the 'end-of-life' analysis of WEEE was recorded and stored in the results analysis database.

The 370 routes were then interpreted individually, analysing them from the starting point (volunteers' home) to the place where the GPS transmitted the last signal. The 'end-of-life' assessment of each WEEE was defined according to the route taken and the type of place where the e-waste arrived at the end of its journey.
The GPS device could stop transmitting on 3 occasions:

a) the WEEE on which it was installed was destroyed;
b) the GPS battery ran out;
c) the GPS device was found, disconnected, switched off or destroyed.

4. Tracking results

The tracking of WEEE disposed of by volunteers in the first half of 2023 continued until the end of August 2023.

The route data of each WEEE was gathered in a database, together with general information on each individual e-waste: type of WEEE, operating state and disposal method chosen by the volunteer. The result was an overall table containing the following information:

- type and operating state of each WEEE;
- place, date and disposal method;
- names and codes of significant destinations (Collection Centres, treatment facilities, residential areas, etc.) reached during the journey with the respective arrival and departure times.

	D	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ
1	Numero dispositivo	tipologia	data arrivo prima destinazione	ora arrivo prima destinazione	Tipologia prima destinazione	Indirizzo prima destinazione	data uscita da prima destinazione	ora uscita da prima destinazione	data arrivo seconda destinazione	ora arrivo seconda destinazione	Tipologia seconda destinazione	Indirizzo seconda destinazione	data uscita da seconda destinazione	ora uscita da seconda destinazione	data terzo spostamento
9	DEVICE 8	Azienda di igiene urbana	n.d.	n.d.	n.d.	n.d.									
10	DEVICE 9	Azienda di igiene urbana	11/04/2023	11:39:51	isola	[redacted]	12/04/2023	11:54:19	12/04/2023	12:24:06	impianto certificato	[redacted]	12/04/2023	15:14:55	12/04/2023
11	DEVICE 10	Centro di Raccolta	27/02/2023	08:20:04	isola	[redacted]	02/03/2023	09:01:35	02/03/2023	10:17:37	isola	[redacted]	02/03/2023	11:28:55	02/03/2023
12	DEVICE 11	Centro di Raccolta	25/03/2023	11:47:13	isola	[redacted]									
13	DEVICE 12	Centro di Raccolta	13/03/2023	08:32:47	isola	[redacted]	13/03/2023	08:41:44	13/03/2023	09:01:24	isola	[redacted]	31/03/2023	17:44:42	31/03/2023
14	DEVICE 13	Azienda di igiene urbana	17/04/2023	10:36:40	isola	[redacted]									
15	DEVICE 14	Centro di Raccolta	18/02/2023	11:13:12	isola	[redacted]	20/02/2023	10:02:54	20/02/2023	10:50:45	transit point	[redacted]	21/02/2023	06:13:08	21/02/2023
16	DEVICE 15	Centro di Raccolta	04/03/2023	11:51:52	isola	[redacted]	15/03/2023	08:53:24	15/03/2023	13:43:43	isola	[redacted]			
17	DEVICE 16	Centro di Raccolta	18/03/2023	10:42:45	isola	[redacted]									
18	DEVICE 17	Centro di Raccolta	04/03/2023	08:24:43	isola	[redacted]									
19	DEVICE 18	Azienda di igiene urbana	29/03/2023	10:34:43	impianto non certificato	[redacted]	29/03/2023	11:14:21	29/03/2023	11:32:14	impianto non certificato	[redacted]	30/03/2023	08:59:46	30/03/2023
20	DEVICE 19	Azienda di igiene urbana	22/02/2023	09:28:55	isola	[redacted]	04/04/2023	09:45:40	04/04/2023	13:11:18	impianto certificato	[redacted]			
21	DEVICE 20	Azienda di igiene urbana	25/02/2023	09:46:01	isola	[redacted]	28/02/2023	15:35:54	28/02/2023	16:35:28	impianto non certificato	[redacted]			
22	DEVICE 21	Centro di Raccolta	18/04/2023	15:45:32	isola	[redacted]									
23	DEVICE 22	Azienda di igiene urbana	20/03/2023	11:01:45	isola	[redacted]	28/03/2023	08:30:56	28/03/2023	11:44:01	isola/raggruppamento/i	[redacted]			29/03/2023
24	DEVICE 23	Centro di Raccolta	18/04/2023	15:26:53	isola	[redacted]	21/04/2023	08:54:15	21/04/2023	16:51:40	impianto certificato	[redacted]			
25	DEVICE 24	Azienda di igiene urbana	02/03/2023	13:46:56	isola	[redacted]	15/03/2023	07:17:32	15/03/2023	07:53:16	impianto certificato	[redacted]			
26	DEVICE 25	Azienda di igiene urbana	31/03/2023	09:11:30	impianto non certificato	[redacted]	04/04/2023	06:37:00	04/04/2023	09:01:55	impianto certificato	[redacted]	13/04/2023	10:35:23	13/04/2023
27	DEVICE 26	Azienda di igiene urbana	04/05/2023	08:59:39	isola	[redacted]	16/05/2023	15:06:02	16/05/2023	17:05:38	isola	[redacted]	17/05/2023	06:59:21	17/05/2023
28	DEVICE 27	Azienda di igiene urbana	20/04/2023	11:27:08	isola	[redacted]	05/05/2023	11:30:54	05/05/2023	12:06:28	impianto certificato	[redacted]			
29	DEVICE 28	Centro di Raccolta	10/03/2023	10:48:05	isola	[redacted]	30/03/2023	09:37:36	30/03/2023	11:56:20	impianto certificato	[redacted]			
30	DEVICE 29	Azienda di igiene urbana	08/03/2023	13:50:45	isola	[redacted]	10/03/2023	08:40:19	10/03/2023	11:17:13	impianto certificato	[redacted]			
31	DEVICE 30	Azienda di igiene urbana	07/03/2023	11:21:00	isola	[redacted]	11/03/2023	12:20:10	11/03/2023	17:46:10	isola	[redacted]			
32	DEVICE 31	Azienda di igiene urbana	06/03/2023	07:42:46	isola	[redacted]	08/03/2023	08:26:23	08/03/2023	11:07:06	impianto certificato	[redacted]			
33	DEVICE 32	Centro di Raccolta	22/04/2023	14:31:36	isola	[redacted]	26/04/2023	14:01:59	26/04/2023	15:07:50	impianto certificato	[redacted]			
34	DEVICE 33	Azienda di igiene urbana	23/03/2023	10:46:06	impianto non certificato	[redacted]	23/03/2023	11:12:48	23/03/2023	11:15:46	isola	[redacted]	24/03/2023	09:22:44	24/03/2023
35	DEVICE 34	Rivenditore di AEE	02/03/2023	12:57:48	isola	[redacted]	14/03/2023	10:32:28	14/03/2023	13:13:52	impianto certificato	[redacted]			
36	DEVICE 35	Rivenditore di AEE	07/03/2023	17:51:11	isola	[redacted]	10/03/2023	11:01:46	10/03/2023	11:43:24	impianto certificato	[redacted]			
37	DEVICE 36	Centro di Raccolta	n.d.	n.d.	n.d.	n.d.									
38	DEVICE 37	Centro di Raccolta	06/03/2023	08:24:04	isola	[redacted]	21/03/2023	17:09:18	30/03/2023	10:58:11	impianto certificato	[redacted]	31/03/2023	14:09:15	31/03/2023
39	DEVICE 38	Centro di Raccolta	31/03/2023	08:54:24	isola	[redacted]	12/04/2023	10:51:54	12/04/2023	16:51:56	impianto certificato	[redacted]			
40	DEVICE 39	Centro di Raccolta	14/04/2023	09:59:38	isola	[redacted]	20/04/2023	07:33:02	20/04/2023	11:26:31	impianto certificato	[redacted]	05/05/2023	14:26:31	05/05/2023

Figure 6: Extract from the overall table containing timely information on all monitored cases.

4.1. Geographical distribution of the sample and starting points

The geographical distribution of the sample used on the national territory is shown in the following figure:

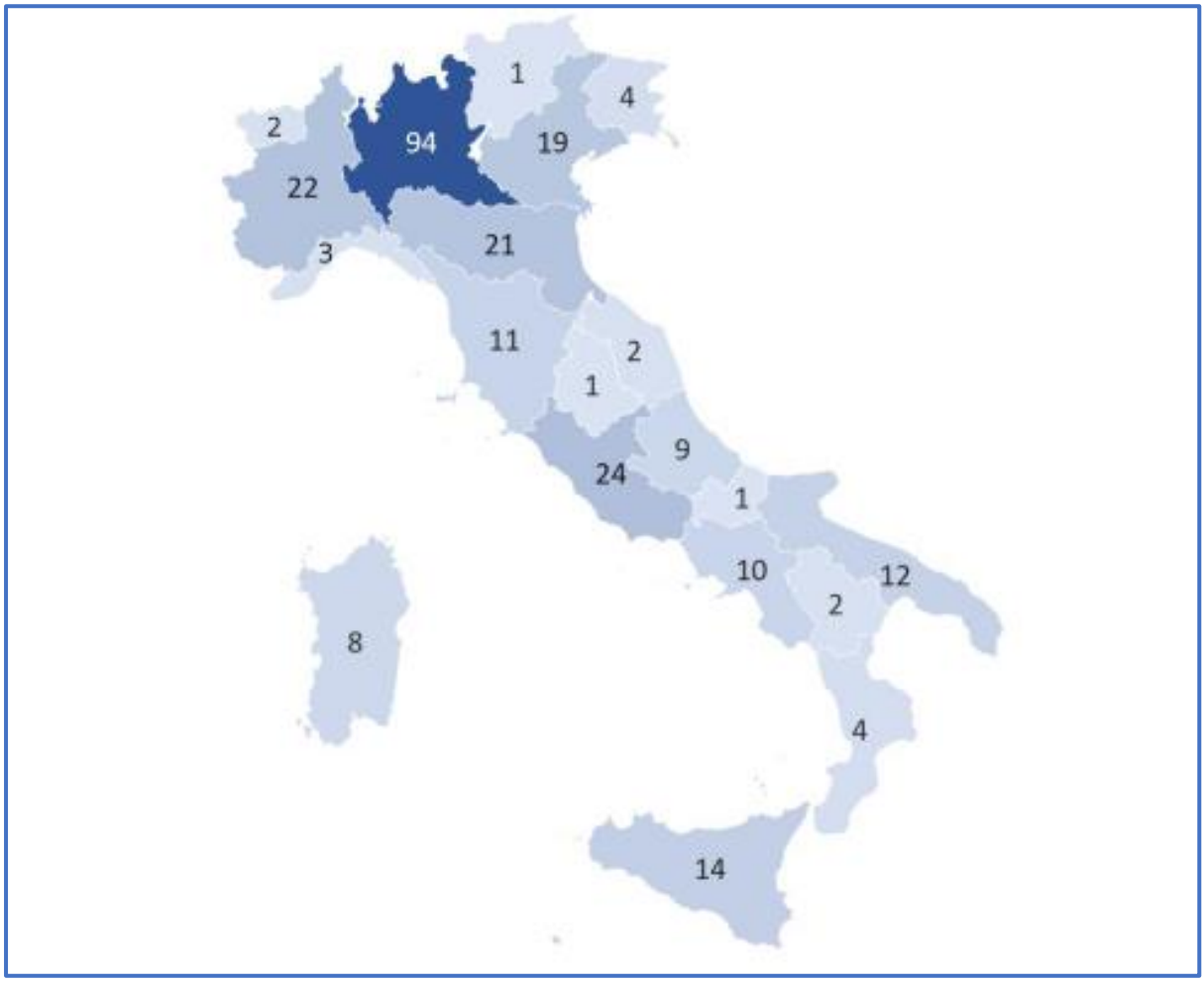


Figure 7: Regional distribution of cases considered valid for the investigation.

Of the 370 cases processed, 106 cases were considered not valid as:

- the GPS tracker was defective and did not provide useful information for the analysis;
- the transmission was interrupted at the place of first disposal.

264 cases were therefore valid for the investigation.

Groupings

Within the analysed sample there is WEEE from 4 Groupings: R1, R2, R3 and R4. The two most represented Groupings are large appliances, i.e. R1s and R2s, with 101 and 126 WEEE respectively. Together, these account for 86% of cases.

Conversely, Groupings R3 and R4 are the minority in our investigation, with 23 and 14 WEEE respectively.

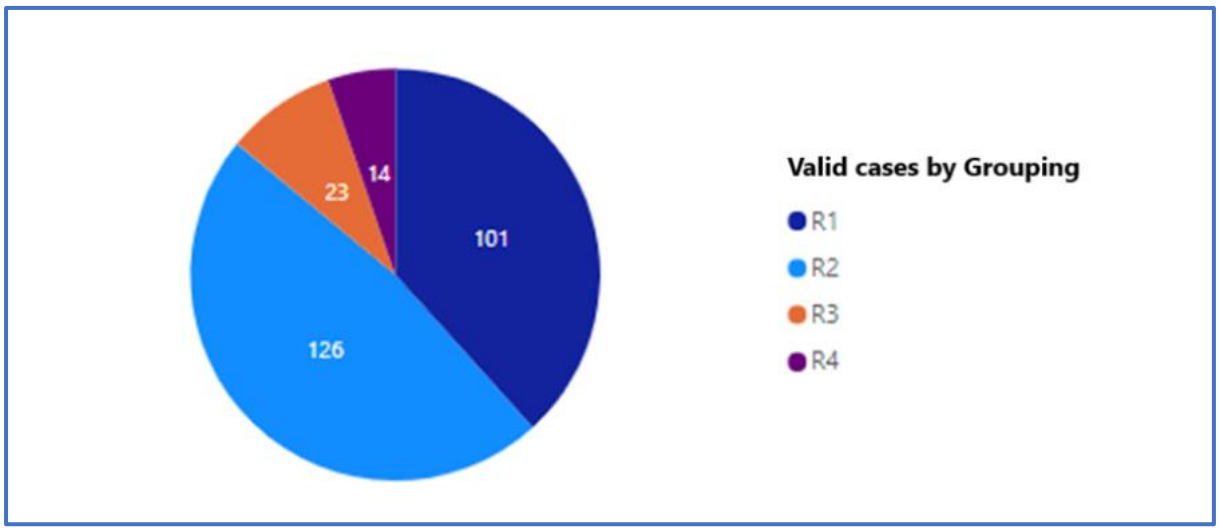


Figure 8: Distribution based on the WEEE Grouping of cases considered valid for the investigation.

By analysing the devices in the individual Groupings in detail, it is possible to note the distribution of the different types of WEEE considered in the investigation.

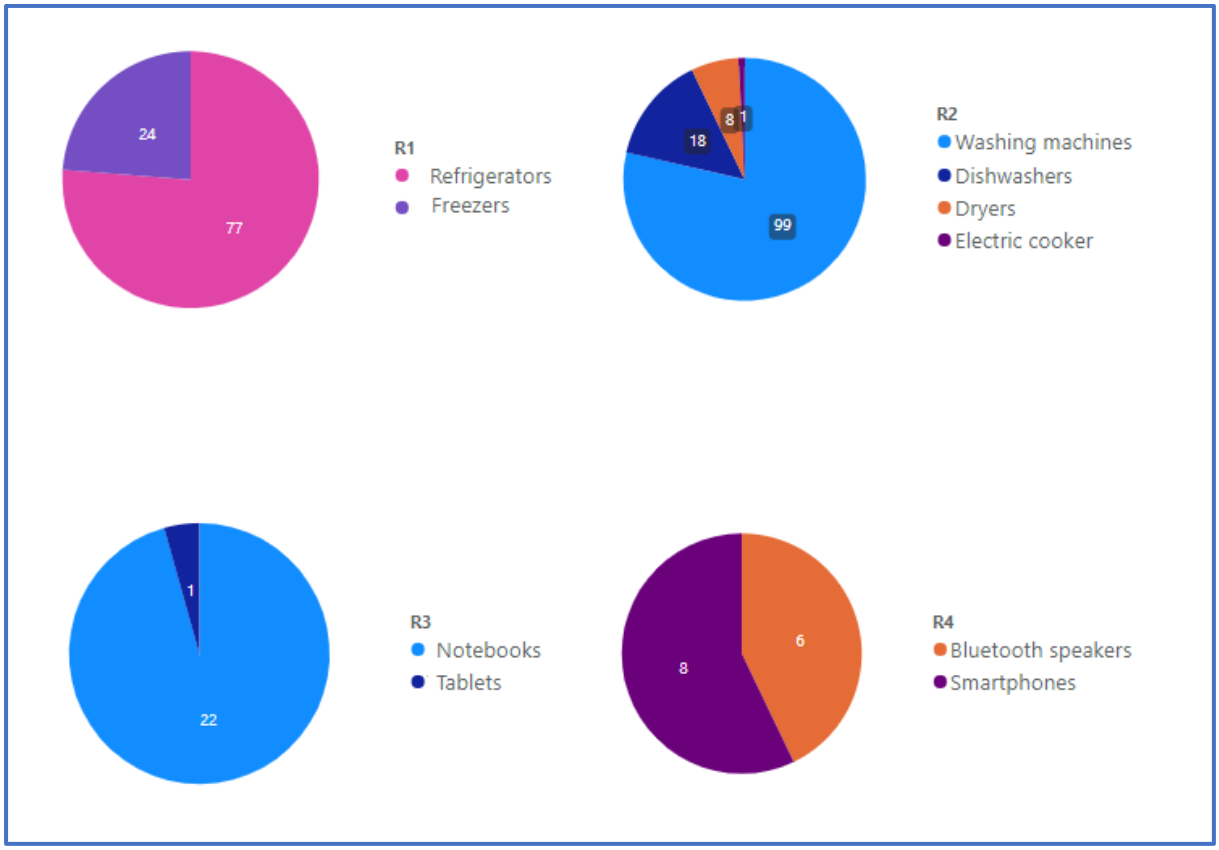


Figure 9: Distribution of product types across the four WEEE Groupings of cases considered valid for the investigation.

As shown in the graph, Grouping R1 sees a clear majority of refrigerators with as many as 77, compared to 24 freezers; Grouping R2 is dominated by washing machines (99) but there are also dishwashers (18), dryers (8) and 1 electric cooker.

Grouping R3 is made up almost exclusively of notebooks (22) and a single tablet. Grouping R4, the smaller one, is made up of 8 smartphones and 6 Bluetooth speakers.

Disposal method of the 264 valid cases

The 264 WEEE with a valid route were disposed of by citizens in four different ways, freely chosen by them:

- **140** devices and appliances were delivered directly to Collection Centres;
- **98** were collected from homes by the urban hygiene company;
- **25** were delivered to retailers of Electrical and Electronic Equipment;
- **1** was left to an entity active in the recovery of ferrous metals.

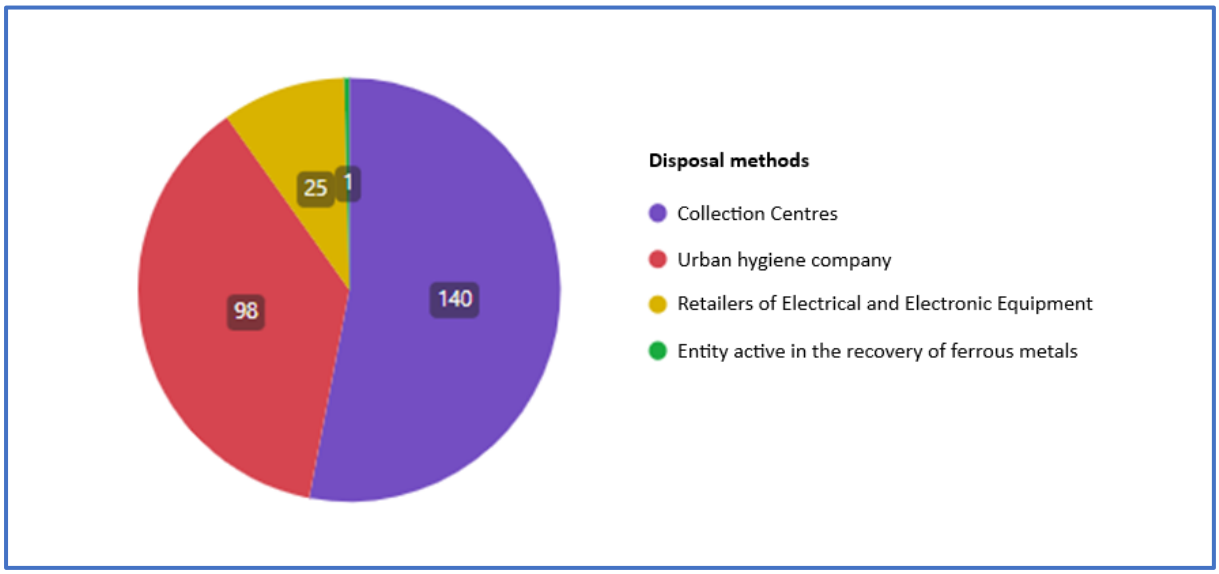


Figure 10: Distribution of disposal method of the cases considered valid in the investigation.

The way in which small WEEE is disposed of deserves an overview: although smartphones and tablets meet the size requirements to be handed in to EEE retailers, most of them were taken to Collection Centres even though these are often located in peripheral areas difficult to reach. This behaviour confirms the citizens' lack of knowledge about the different ways of disposing of WEEE, in particular the **One-to-Zero** mode, which allows consumers to leave their small WEEE to large electronics stores completely free of charge, without the need to buy a new product. The issue of WEEE has gained importance over time, but in-depth knowledge and information are not yet at a satisfactory level: the disposal procedures envisaged by the regulations are not yet known by the majority of citizens, who need to be facilitated in practising correct behaviour. There is therefore a need to communicate more about these issues through large-scale awareness-raising campaigns.

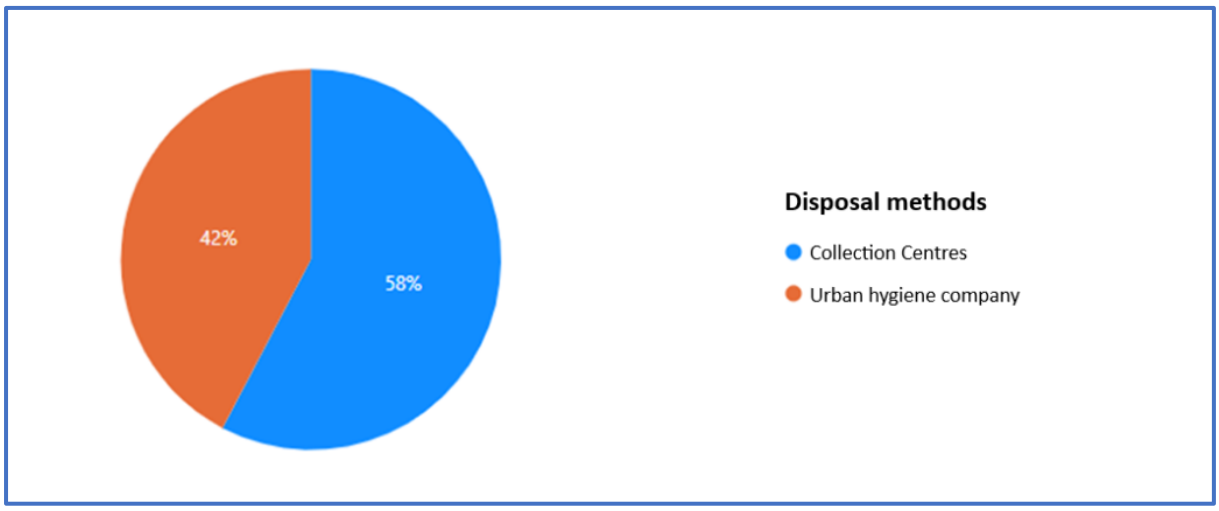


Figure 11: Distribution of the disposal method of all devices belonging to Groupings R3 and R4 disposed of in the investigation.

Operating state of the WEEE investigated

Volunteers taking part in the investigation filled in a preliminary questionnaire, which allowed us to obtain information regarding the type and operating state of WEEE and the chosen method of disposal, and thus to know in advance how the sample would be made up.

For the 370 WEEE disposed of, and not only for the 264 cases found to be valid for the analysis, an assessment can be made as to their condition.

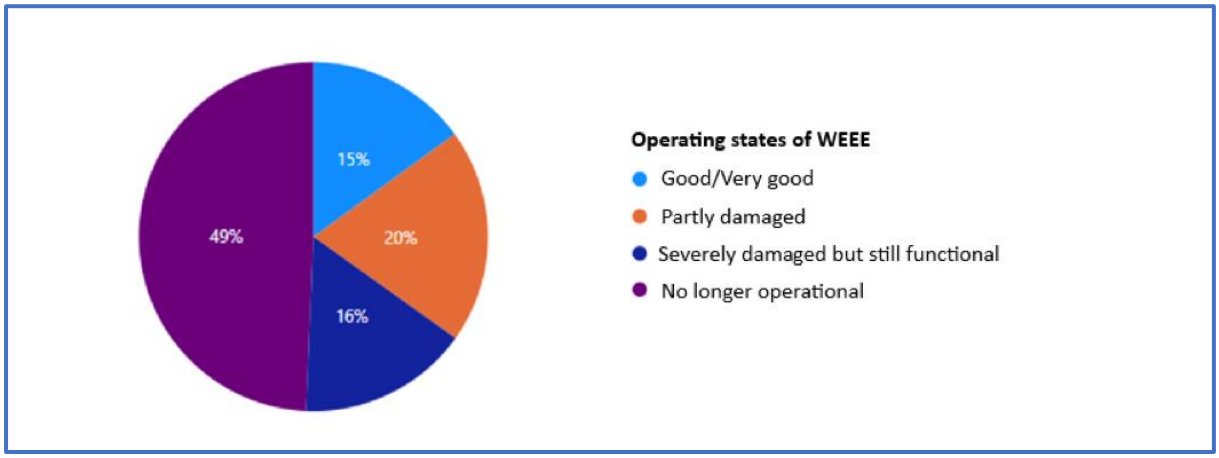


Figure 12: Distribution of the operating state of all devices disposed of in in the investigation.

Overall, almost 50% of the WEEE disposed of for the investigation was still in working order, and more than 12% was in very good condition at the time of its disposal.

If we take into consideration only small WEEE, the percentage of devices still functioning exceeds 60%, and the percentage of those in very good condition reaches 37%.

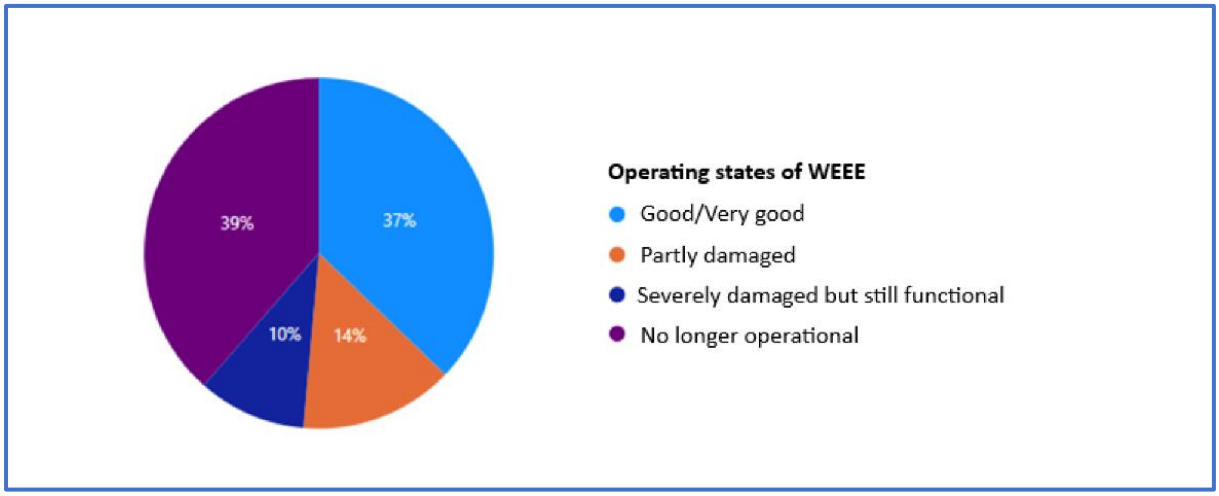


Figure 13: Distribution of the operating state of all devices belonging to Groupings R3 and R4 disposed of in in the investigation.

It is to be hoped that the European Commission's new rules aimed at promoting the repair of goods will lead to more consumers preferring repair over replacement. **For the Circular Economy, the concept of waste reduction is fundamental.**

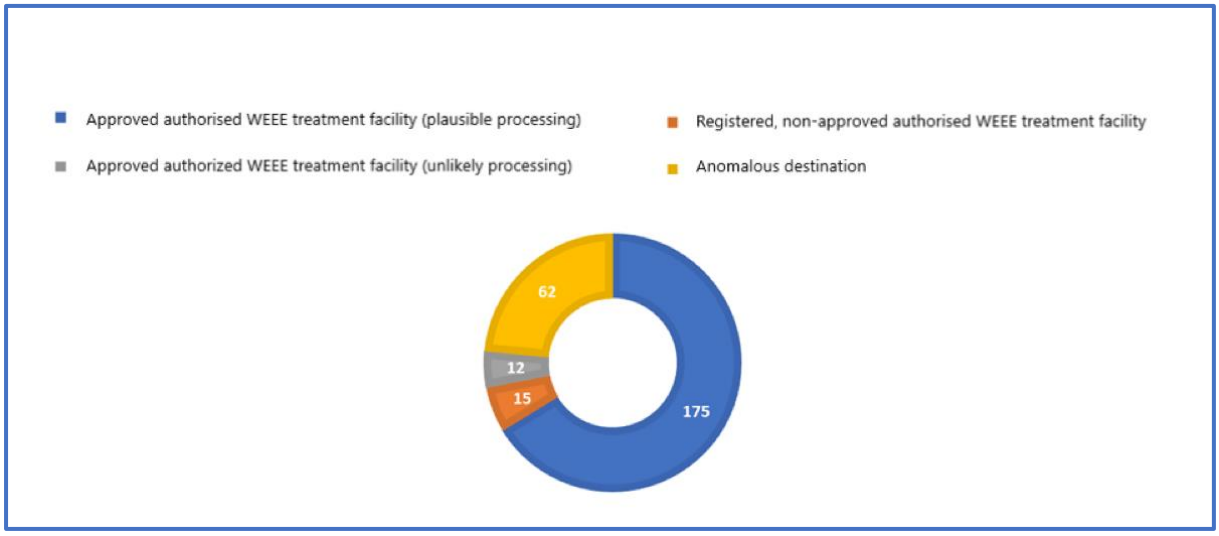
4.2. Results

As stated at the beginning of this report, the aim of our investigation was to examine the flows parallel to the formal circuit – which prevent the achievement of the targets imposed by the European Union – and to check whether and how much had changed since the investigation carried out in 2019. Unfortunately, **very little has changed in these four years**.

Although it is not possible, due to a different method of evaluation, to make a precise comparison between the results of this investigation and those of the previous one, we found similar situations with the presence, once again, of unauthorised actors intercepting WEEE, and with similarities in the routes: WEEE ending up abroad or in private homes, sometimes sold through flea markets, etc. Although the size of the sample does not allow the investigation to be considered a statistically significant document, a clear picture emerges of the problems affecting the management of e-waste in our country.

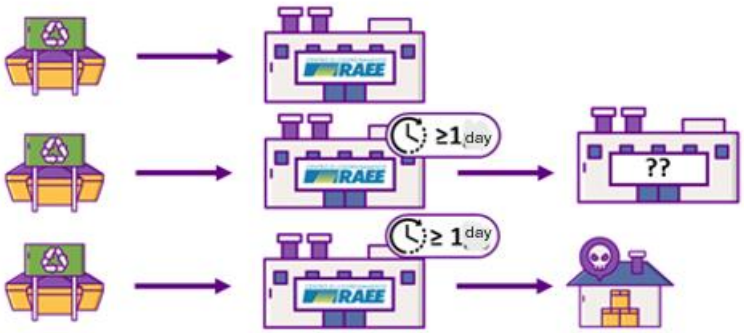
The 264 e-waste considered, after being disposed of by volunteers followed different routes. From the tracings we could see that some arrived at authorised WEEE treatment facilities while others followed different roads, even outside the formal circuits. To facilitate the analysis of the results, we categorised the different routes into four different clusters:

- Approved authorised WEEE treatment facility (plausible processing): 175 cases
- Registered, non-approved authorised WEEE treatment facility: 15 cases
- Approved authorised WEEE treatment facility (unlikely processing): 12 cases
- Anomalous destination: 62 cases



1. **Approved authorised WEEE treatment facility (plausible processing)**

WEEE in this first category arrived at an approved authorised WEEE treatment facility and remained there for at least 24 hours, which is sufficient time to assume that the waste was processed. In some cases, it may be assumed that the waste fraction containing the GPS tracker continued its journey to other destinations (e.g. other WEEE facilities, authorised landfill, etc.).



This group describes the ideal flows as WEEE is managed by treatment facilities approved authorised by the Centro di Coordinamento RAEE and which comply with the quality standards defined for the treatment of this type of waste.

BACKGROUND: *In order to treat WEEE, a treatment facility must comply with three requirements: 1) Be in possession of a regular authorisation to treat WEEE; 2) Register with the WEEE Clearing House; 3) Periodically report to the WEEE Clearing House the volumes treated.* ***If the facility wants to operate as a supplier to the Collective Systems and receive from them the WEEE to be treated****, it must first* ***pass the WEEE Clearing House accreditation audit****.*

2. **Registered, non-approved authorised WEEE treatment facility**

WEEE within this second category reaches a ***registered*** WEEE treatment facility but not an approved authorised one to the Centro di Coordinamento RAEE and ends its journey there.

BACKGROUND: *A registered WEEE treatment facility,* ***but not approved authorised to the Centro di Coordinamento RAEE****, must also compulsorily comply with the above-mentioned requirements (1. Authorisation; 2. Registration with the WEEE Clearing House; 3. Periodic reporting to the same). However, since such a facility can operate without complying with the treatment quality standards defined by the WEEE Clearing House and without undergoing the relevant audits,* ***cannot receive WEEE from the Collective Systems****.*

3. **Approved authorised WEEE treatment facility (unlikely processing)**

WEEE included in this third category pass through an approved authorised WEEE treatment facility but remain there for a period of time that is not sufficient to suggest that processing had actually taken place. After the short stop, the WEEE continues on its journey to other destinations (e.g. other WEEE facilities, steelworks, etc.).

This is an incorrect route, as WEEE is first delivered to facilities that guarantee the highest quality processing levels, but instead of being processed in these facilities, it is immediately handed over to other entities who do not carry out the treatment according to the quality standards imposed by the Centro di Coordinamento RAEE.

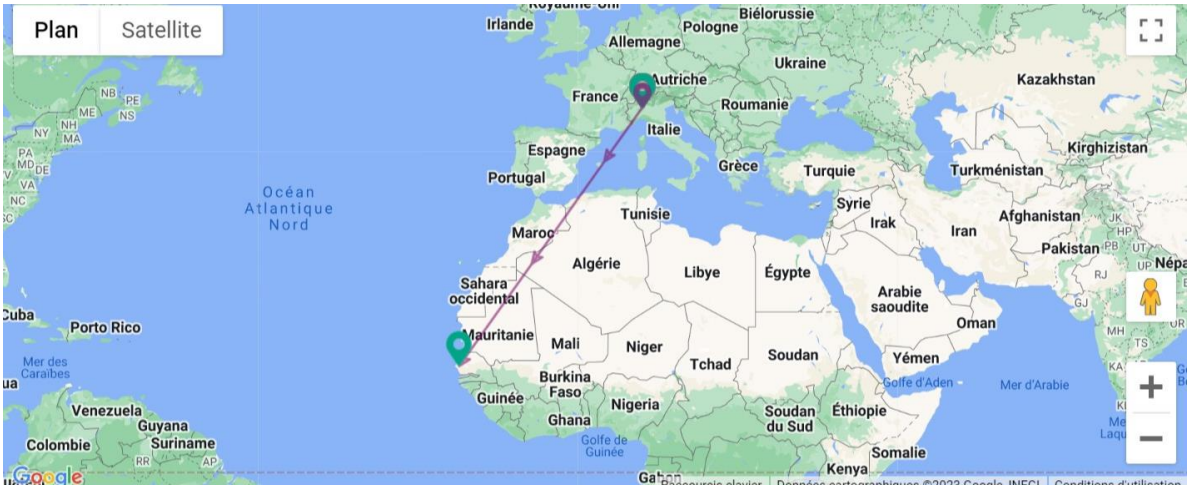
The subsequent destination to the approved authorised WEEE treatment facility most often turned out to be a registered WEEE treatment facility, but there was no shortage of steelworks and ferrous metal recovery and recycling companies, even across national borders.

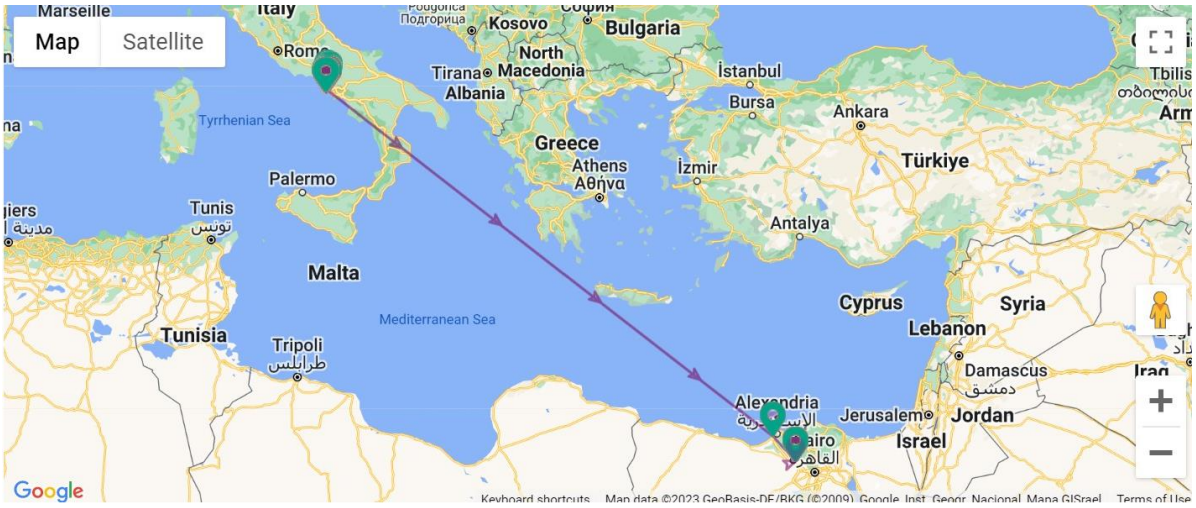
4. Anomalous destination

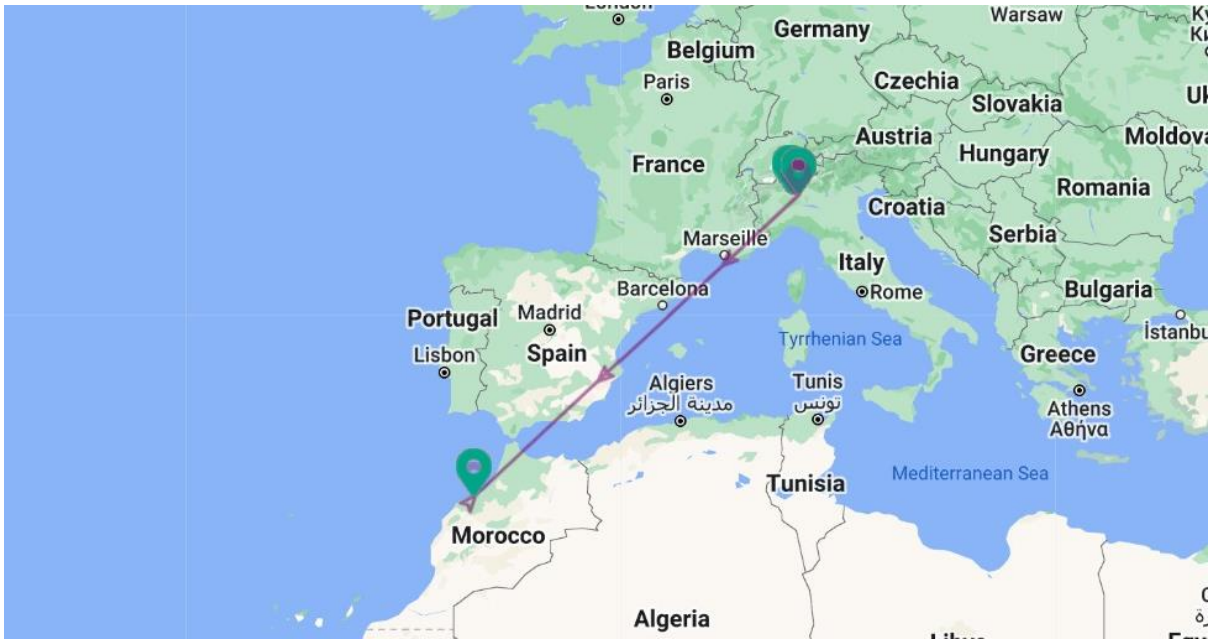
In this last category we include WEEE that follows an incorrect route. The waste, in fact, from its place of disposal it reaches a destination other than the intended one (e.g. WEEE is handed over to industrial entities not registered with the WEEE Clearing House).

This cluster represents an **illegal flow** because during its journey WEEE never passes through authorised facilities to treat it. Its informal and inadequate management poses risks to human health and the environment. Furthermore, WEEE belonging to this flow, which escapes any control, is not even reported, contributing to the failure to reach the collection and recycling targets imposed under EU Directives.

The anomalous destinations found are the most varied. For example, following the tracings of Grouping R3, we found that 3 notebooks arrived in Africa after leaving national ports and landing in Senegal, Egypt and Morocco.







In other cases, the transmission stopped at residential areas where the tracker's battery discharged completely, or where the tracker has been detected and disabled. In addition, there is no shortage of WEEE dumped in illegal landfills or delivered directly to steelworks or ferrous metal recovery and recycling businesses without being processed.

4.3. Tracking examples for each category

Approved authorised WEEE treatment facility (plausible processing): GPS #147

The refrigerator is collected at 4.09 pm on 2 May 2023 by the urban hygiene company, which delivers it to the Collection Centre at 4.30 pm on 2 May. On 16 May at 2.03 pm it leaves the Collection Centre and is taken to the approved authorised WEEE treatment facility, where it arrives at 4.01 pm. The tracker stops generating signals at 9:26 am on 17 May when the refrigerator is processed.

Collection Centre

Approved authorised WEEE treatment facility

Registered, non-approved authorised WEEE treatment facility: GPS #67

The washing machine is delivered directly by the volunteer to the Collection Centre on 21 March 2023 at 4.45 pm. On 22 March 2023 at 12:04 pm it leaves the Collection Centre and is transported to a registered, non-approved authorised WEEE treatment facility, where it arrives at 12:23 pm. It remains there until 3 May.

At 4.28 pm it is transported to a second registered WEEE treatment facility where it arrives at 4.49 pm. The tracker stops transmitting on 9 May at 9:51 am, when the washing machine is processed.

Collection Centre

First registered WEEE treatment facility

Second registered WEEE treatment facility

Approved authorised WEEE treatment facility (unlikely processing): GPS #48

The washing machine is delivered directly by the volunteer to the Collection Centre on 11 March 2023 at 1:53 pm, where it remains until 20 March when, at 10:42 am, it leaves to be delivered to an approved authorised WEEE treatment facility where it arrives at 8:28 am on 21 March. Here it remains only six hours, a period of time that is not sufficient for proper processing and separation from the tracker: at 2:29 pm it leaves the facility to be delivered, at 2:46 pm, to a scrap dealer across the border. The last transmission is on 22 March at 7:20 am, when the washing machine is put under the press.

Collection Centre

Approved authorised WEEE treatment facility

Plant across the border

Anomalous destination: GPSM11

The notebook is delivered directly by the volunteer to the Collection Centre on 24 February at 4.24 pm. There it remains for just 8 minutes, leaving the Collection Centre at 4.32 pm, to be delivered, after a five-day stop in a residential area, to a collection site for scrap iron and metal on 1 March 2023 at 4:01 pm. There it remained for two months, leaving at 12:45 pm on 1 May 2023, to be delivered to the port of Naples at 5.12 pm, where it remained until 13 May, when it left for Egypt. On 24 May at 1:28 am it stops transmitting at a steelworks, when the notebook is dismantled to be melted down, or the tracker is removed and destroyed.

Route

Steelworks in Egypt

5. Conclusions

EU countries collect and manage more WEEE in an environmentally sound manner than the rest of the world. However, this commitment is still not sufficient to reach the collection targets set. Italy is particularly lagging behind: in 2022 the WEEE return rate in our country stopped at 34%, compared to the much more ambitious European target of 65%[4]. This gap is in large part due to the existence of informal WEEE management flows, namely that grey area made up of illicit trafficking, inadequate treatment, and potentially harmful to human health and the environment, in which all too often Waste Electrical and Electronic Equipment that escapes the 'formal' System managed by the Producers' Collective Systems ends up.

In addition to environmental damage, the improper management of this equipment leads to the loss of the possibility of recycling Secondary Raw Materials and Critical Raw Materials that are fundamental and strategic for our country.

The results of the investigation – which can be made available to the competent authorities if requested – show that there is a system of parallel flows that survives and thrives thanks to inadequate controls.

This investigation once again highlights the core of the problem: the need to increase controls along the entire chain. It is necessary to search for WEEE at facilities that handle other types of waste (ferrous and non-ferrous scrapyards, auto breakers, etc.). It is necessary to check the containers departing from Italian ports to Africa or Asia to verify whether they really contain EEE that is still functioning or only WEEE, and, if necessary, step up the sanctions against those who divert WEEE from the 'formal' System.

It is no longer acceptable that the efforts made by EEE Producers to design and manufacture equipment with a lower environmental impact – and by their Collective Schemes to ensure proper WEEE management – should be thwarted by actors who use WEEE solely for their pursuit of profit, seizing the easiest materials to extract in the cheapest way, without the slightest care for the environmental aspect. This is not Circular Economy: it is only private interest and it is no longer acceptable.

[4] Starting from 2019, the minimum WEEE collection rate to be achieved annually is 65% of the average weight of EEE put on the market in the previous three years, or alternatively 85% of the weight of WEEE generated annually in the territory.