HOUSEHOLD WEEE GENERATED IN ITALY

ANALYSIS ON VOLUMES & CONSUMER DISPOSAL BEHAVIOR FOR WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT

ECODOM
Consorzio Italiano
Recupero e Riciclaggio
Elettrodomestici

In keeping with its mission as established by the member Producers, ever since it started operations in January 2008, Ecodom has always sought to attain environmental excellence and economic efficiency.
I believe that just a few figures are sufficient to prove that during its first five years, the Consortium has genuinely succeeded in achieving these two aims:

- in 2011, of the almost 38,000 withdrawals of waste from Collection Facilities, 99.9% took place within the response times agreed by the ANCI (National Association of Italian Municipalities) and the WEEE Clearing House;
- thanks to the terms of the contracts signed with the Category R1 WEEE treatment facilities and the regular inspections performed at these locations, the quantity of ozone-depleting gases extracted from refrigerators tripled during 2008-2010;
- Ecodom has always passed the benefits of its operational efficiency on to Consumers, by gradually reducing the WEEE recycling fees charged (cuts came into force on 1 January 2009, 1 July 2010 and 1 April 2012).

Moreover, as well as working to standards of excellence and efficiency, Ecodom has always striven to provide its stakeholders (Parliament, Government, Local Authorities, utility companies, Distributors, environmental and Consumer associations, etc.) with data for consideration and opportunities for debate, including:

- the first study of the energy and environmental impacts of the recycling of Waste Electrical and Electronic Equipment, undertaken jointly with Ambiente Italia in 2008;
- the campaign Uno contro Uno. Conosciamo il valore di un rifiuto RAEE. Impariamo a gestirlo con responsabilità ["One-to-One. What WEEE is worth and how to manage it properly"] to raise awareness about correct WEEE management, undertaken by the Cittadinanzattiva movement in 2010;
- the survey of Italians' awareness of the importance of recycling and correct WEEE management, carried out by Ipsos in 2011.

Continuing this policy, early in 2012 Ecodom decided to commission a team from the Milan Polytechnic and Ipsos, under the guidance of the United Nations University (UNU), to undertake research to establish the amount of household WEEE generated in Italy every year.
This study comes in the wake of a similar project carried out by the Dutch WeCycle Consortium, which revealed that it will not be possible to achieve the new WEEE collection targets set by the European Union unless the individual member States accept responsibility for identifying and tracing all the WEEE which currently vanishes into often illegal flows of waste, causing a serious environmental threat as well as significant losses in financial terms.
With effect from 2019, every European Union member State will be required to collect and properly dispose of 85% of the WEEE generated within its borders every year, and there is a risk that the Italian WEEE System will not be ready for that date (actually nearer than it may seem), unless it is reinforced by means of suitable legislation and through a greater synergy between all those involved in the WEEE management chain. I hope that the publication of the findings of the study will prove a first step in this direction.

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EXECUTIVE SUMMARY

In 2012, the European Parliament approved the text of the new WEEE (Waste Electrical and Electronic Equipment) Directive, including the collection target for each Member State from 2019 onwards of 65 per cent of the annual average of Electrical and Electronic Equipment (EEE) put on market (PoM) over the three preceding years (65% PoM) or 85 per cent of the annual average of WEEE generated (85% WG). In 2011, the formal WEEE system in Italy collected only 4.29 kg/inhabitant. Although this data is limited to household waste, it nonetheless highlights the need and substantial room for improvements in the collection system and the considerable gap between Italy and many other European countries.

This study, for the first time in Italy, provides evidence that will support the development of more accurate future collection targets, quantifying household WEEE generated and highlighting consumers' WEEE disposal habits and attitudes, as well as shedding light on complementary/alternative waste streams, which, to date, account for a substantial share of WEEE arising in Italy.

A combination of detailed reconstruction of the historical put on market data for different types of EEE, the quantification of the accumulated EEE stocks in households, and the creation of life-time profiles for various EEE, has enabled the formulation of reliable estimates of WEEE generated annually in Italy.
These WEEE streams have been categorized into different disposal channels in order to highlight key aspects of WEEE collection and management to which legislators must pay particular attention in the definition of future strategies for achieving WEEE collection targets.
Below are the key findings of the study, based on data on household WEEE streams in Italy in 2011:

- household EEE put on market in 2011 amounted to 18.3 kg/inhabitant. The average annual EEE put on market over the three preceding years (2008-2010) was 18.5 kg/inhabitant. For 2011, then, the 65% PoM collection target was 12 kg/inhabitant;

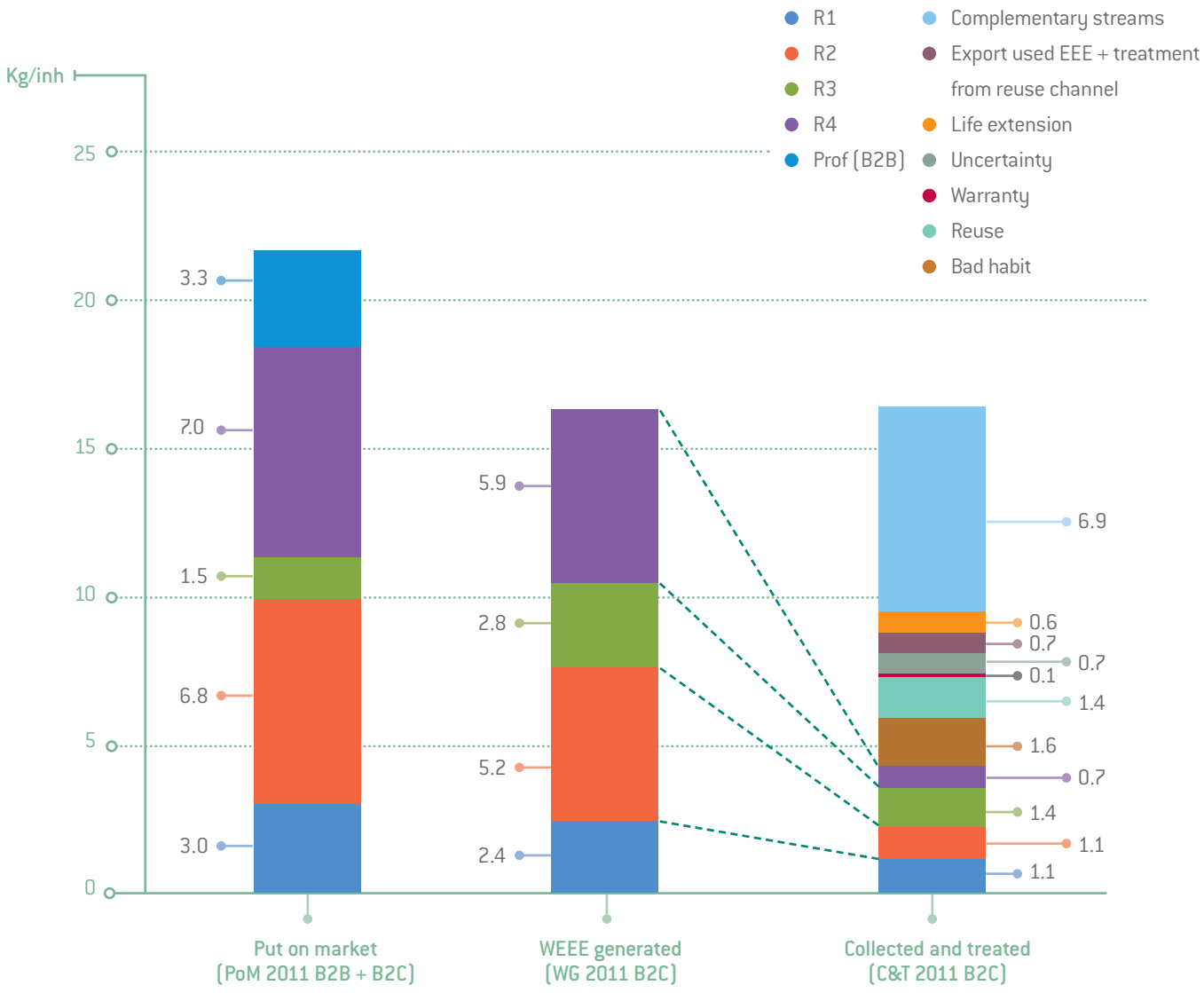
- household WEEE generated in 2011 amounted to 16.30 kg/inhabitant, meaning that the 85% WG collection target was 13.8 kg/inhabitant;

- the formal WEEE system collected and treated 4.29 kg/inhabitant, which amounted to only 35.8 per cent of the PoM target of 12 kg/inhabitant and 31.1 per cent of the WG collection target of 13.8 kg/inhabitant;

- of all WEEE generated, 12.9 per cent (2.1 kg/inhabitant) was sold or given away for re-use, though only 1.4 kg/inhabitant (which represent 8.6 per cent of total WG) are actually re-used. The remaining 0.7 kg/inhabitant are exported as used EEE or sent elsewhere for treatment as WEEE. An additional 0.6 kg/inhabitant (3.7 per cent of total WEEE generated) was left by consumers in old houses. Together, these WEEE streams represent 16.6 per cent of total WEEE generated. Proper accounting of such streams is necessary, reducing where necessary the overall quantity of WEEE generated in target definition;

- In 2011, municipal collection points and retailers are estimated to collect 11.2 kg/inhabitant (68.7 per cent of WG), though only 38.3 per cent (4.29 kg/inhabitant) of this amount has been managed by the formal WEEE system. To date, a share of WEEE generated is directly sent to treatment from municipal collection points and retailers. The large volume of WEEE collected by municipal collection points and retailers, much of which eludes the formal WEEE system in Italy, further reinforces the importance of proper accounting of all complementary waste streams.

Figure 1 – Streams of EEE and WEEE in Italy in 2011 (kg/inhabitant), excluding lamps.



Please consider in the following: R1 (cooling & freezing equipment), R2 (large household appliances), R3 (TVs & monitors) and R4 (mixed WEEE).

This report outlines the methodology that led to the construction of the three pillars used to calculate WEEE generated: EEE put on market, household stocks and life-time profiles. The report also discusses in more detail key aspects related to each waste stream and disposal channel in order to support policies and practices aimed at achieving Italy's WEEE collection targets.

INTRODUCTION

Compared to traditional waste streams, waste electrical and electronic equipment (WEEE or e-waste) presents some unique and complex challenges, including:

- the high heterogeneity of electrical and electronic equipment (EEE) – ranging from refrigerators to tablets, from car-radios to washing machines – in terms of size and weight, features, and material composition (all of which change over time, even for the same products, as technologies change and the ratios of electronic components increase);

- the continuous introduction of new products and features, such as navigation systems and smart-phones, along with a progressive reduction in the average lifespan of products and the phenomenon of massive replacement of EEE at technological leaps (e.g. the transition from cathode ray tube (CRT) televisions to flat screen televisions);

- the presence of certain constituent elements or potentially dangerous substances in EEE (such as ozone-depleting substances, mercury and other heavy metals). At the end-of-life phase of EEE, these potentially-hazardous components and substances must be properly managed using appropriate technologies in order to ensure that they are treated in a safe and environmentally-sound way;

- use within EEE of certain natural resources (e.g. ruthenium, indium, platinum group metals, rare earth elements) that are considered "critical" due to increasing demand, shortage or geological scarcity, supply risks associated with geological concentrations in particular countries or geographical areas, difficult recovery due to the "dissipative" nature of the elements and the technological complexity of the recovery and recycling process;

- the large number and diversity of actors involved in the lifespan of EEE, ranging from design and production to retail and to recovery and treatment of WEEE. This complex system is in many cases characterized by uncoordinated and sometimes contradictory roles, interests and responsibilities;

- the evolution of the collection and management processes related to this type of waste, including the gradual growth of a dedicated WEEE sector that is developing technologically and becoming increasingly specialized.

Since 2003, with the publication of Directive 2002/96/EC, the European Union has managed WEEE using the Extended Producer Responsibility (EPR) principle, ensuring that producers have the chance to fulfil obligations either individually or collectively. The Directive, transposed in Italy in 2005 with the Legislative Decree 151/2005, has undergone a thorough review process (recast) by the EU between 2006 and 2012, including preparatory studies and impact assessments. After numerous amendments during the voting process, the final text of the new Directive (2012/19/EU) has been published in the Official Journal of the European Union on 24 July 2012.
The new WEEE Directive introduced some important changes in order to strengthen EU efforts on sustainable development, in line with the Fifth Environmental Action Programme, and to overcome some problems that emerged in the early years of implementation in Member States. One of the main changes introduced by the new Directive, which was the subject of considerable debate during all phases of the Recast, concerns the re-definition of the collection target for Member States.

THE NEW WEEE DIRECTIVE AND COLLECTION TARGETS

Directive 2002/96/EC required Member States to achieve a collection target of 4kg/inhabitant of household WEEE by 31 December 2006. The new Directive includes a number of important and fundamental changes regarding collection targets:

- collection targets are no longer defined for all Members States in terms of kg/inhabitant, but are instead related to specific market conditions in individual Member States. After an initial transition period, Member States will be able to choose to have their targets set in terms of the "percentage of the average weight of EEE placed on the market in the three preceding years" or the "percentage of WEEE generated";

- collection targets include not only household WEEE, but also professional WEEE.

Table 1 provides a timeline of the evolution of country-level WEEE collection targets under the new WEEE Directive. The implications of these changes will be discussed below.

Table 1 – Structure and evolution of collection targets under the new WEEE Directive

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
Target	Min 4 kg/inhabitant or average kg/inhabitant collected annually over the previous 3 years (whichever is greater)				45% PoM (annual average from 3 preceding years)			65% PoM (annual average from 3 preceding years) or 85% WG	

Table 2 gives an overview of the relative advantages and disadvantages of setting collections targets based on the amount of EEE put on market or the amount of WEEE generated.

Table 2 – Comparative analysis of target setting criteria

TARGET CRITERIA	ADVANTAGE	DISADVANTAGE	CRITICAL ELEMENTS
EEE put on market	Easier to calculate because all producers are required to declare EEE PoM. This consideration applies without taking into account the "free rider" phenomenon or accuracy of reporting.	Cannot take account of dynamic growth markets (growing markets with limited return for replacement) or declining markets (low PoM, but WG influenced by previous PoM). These aspects are more marked for EEE with longer lifespans (See Figure 13). Cannot account for substitutions or technological jumps, such as the replacement of heavy CRT with lighter LCD (See Figure 3, data Grouping R3). Cannot account for consumer attitudes and behaviours, such as periods of "hibernation" in households (Figure 15) or purchasing new EEE and not disposing of any WEEE (See Tables 11 & 12). Static. Unable to be updated to achieve better accuracy in the evaluation of factors influencing WEEE generation processes.	Most recent PoM data is available only after annual declarations are made to National Register, and there is no coincidence between "calendar year" and "EEE year". The knowledge of PoM amounts is a key element in the calculation of WEEE generated. The accuracy and the identification of potential "free riders" remains a challenge.
WEEE generated	Can take account of market dynamics (expansion or contraction). Can account for phenomena related to technological leaps. Can account for consumer attitudes and behaviours. Can be updated in real time, based on new data/evidence, to increase the accuracy and precision of estimates.	It is necessary to develop a methodology ad-hoc for the calculation of WEEE generated, taking into account multiple influencing factors.	
Put on market and WEEE generated	Consideration must be given to "fixed installations" of EEE in the evaluation of put on market. It is necessary to take account of EEE inside/outside the scope. Evaluations of overall performance must take into account products exported to other countries for re-use, as they are products placed on the domestic market that will not be collected and processed in Italy. Due to the heterogeneity of EEE and the resulting diversity of treatment considerations, it is necessary to quantify targets for specific product groups (See Figure 3, particularly waste stream R3, Figure 13 and Table 10).		

The objective of this study is to provide, for the first time in Italy, evidence and data in support of the development of more accurate future national collection targets definition. To do this, the report draws on and analyzes:

- historical trends in the amount of EEE put on market;
- household stocks of EEE and average product life-times;
- average age of discarded products and the main channels for the disposal of household WEEE;
- descriptions of and comparisons between main complementary WEEE streams (i.e. WEEE streams that are not managed by the formal WEEE system) and the formal WEEE system, as implemented in Italy in accordance with Legislative Decree no. 151/2005.

These elements are used to create a model for the estimation of household WEEE generated, providing the Italian State with a reliable starting point for defining future strategies for achieving the collection target, regardless of the methods of calculation used (PoM or WG). Although the focus of the study has been limited to household WEEE from waste streams R1 (cooling & freezing equipment), R2 (large household appliances), R3 (TVs & monitors) and R4 (mixed WEEE), the methodology can be extended also to professional WEEE and R5 (lamps).
Under the clearinghouse framework (CdC RAEE), the amount of household WEEE managed by the formal sector has increased steadily, from 1.10 kg/inhabitant in 2008, the year in which the system started its gradual assumption of the volumes previously managed by municipalities, up to 4.29 kg/inhabitant in 2011.
Italy's overall performance, however, remains lower than the performance of many European countries, although it is still in line with the target set by the WEEE Directive. This performance gap is notable not only when compared with countries where a formal system for the management of WEEE was already in place before Directive 2002/96/EC (e.g. Sweden, Denmark, Belgium and the Netherlands), but also when compared with countries where no similar legislation was in place before the WEEE Directive (e.g. Ireland, Germany, the UK and France).

Figure 2 – Total WEEE collected in 2010 by European countries (source: Eurostat)

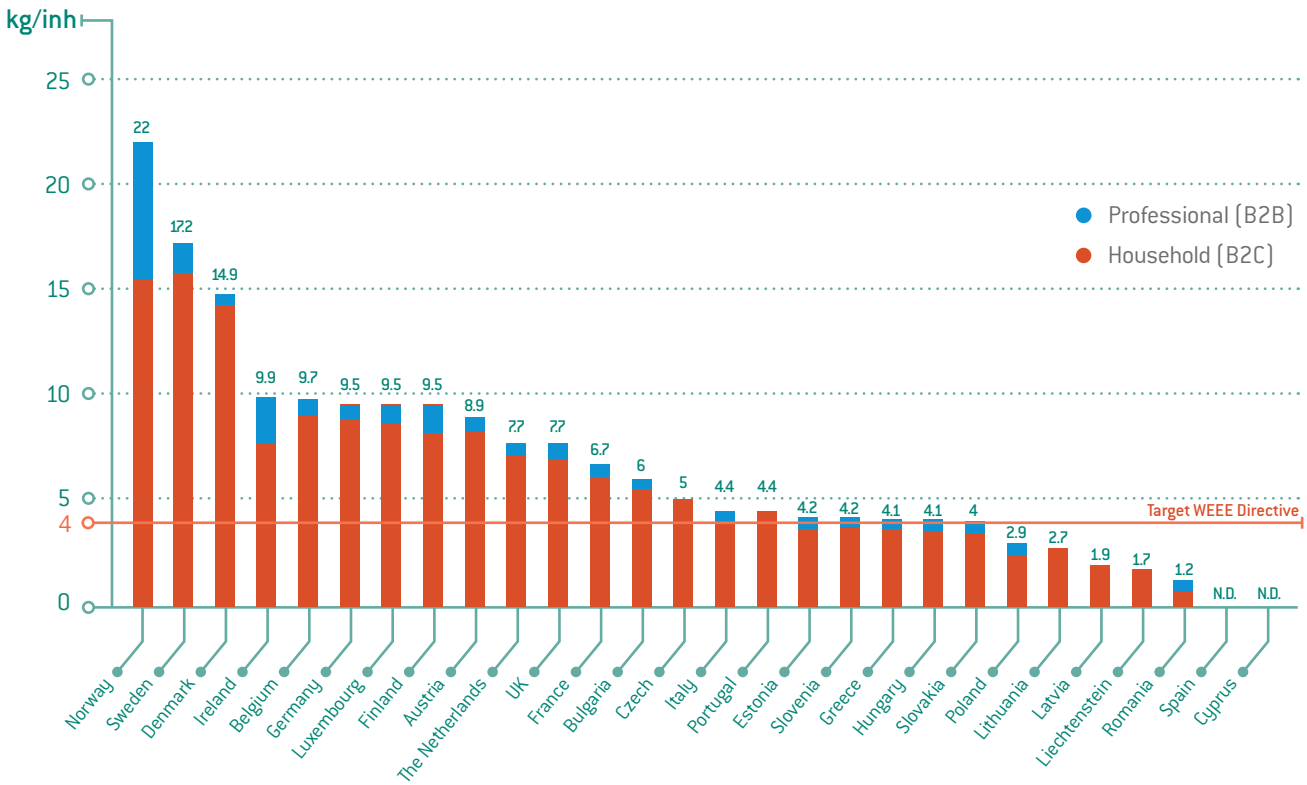
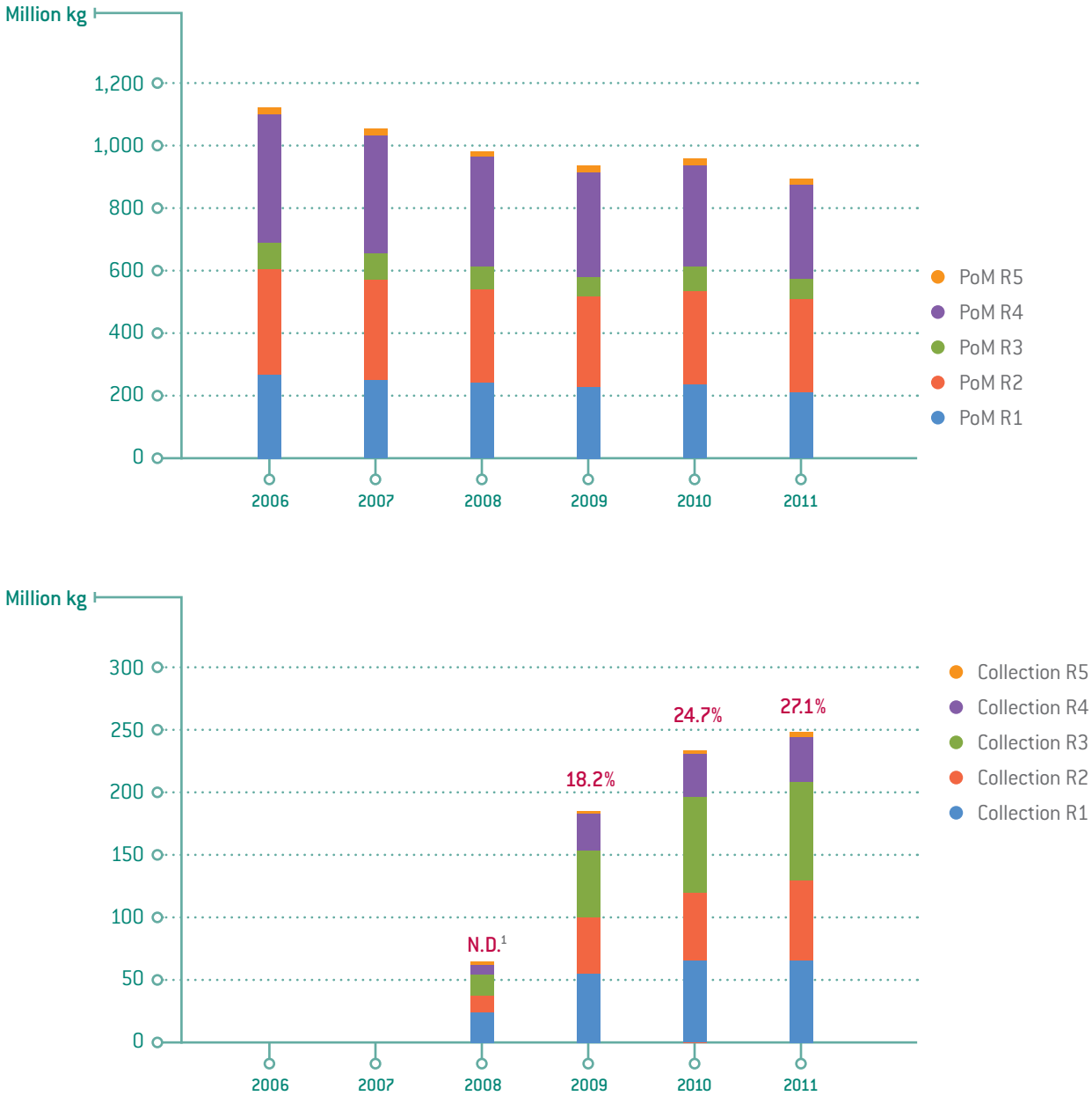


Figure 3 shows the amount of WEEE managed by CdC RAEE, which represents only those volumes reported to compliance schemes, and the total amount of EEE put on market in previous years, based solely on data reported to the CdC RAEE from compliance schemes.

Figure 3 – Performance of the WEEE system in achieving targets set under the new WEEE Directive (PoM). Only data provided by compliance schemes



These data suggest the need for a profound reflection by the Italian Government, and the Ministry of Environment, in particular, regarding the strategy to reach the collection target set by the new WEEE Directive.

1 Average PoM 2005-2007 not available.

THE WEEE SYSTEM IN ITALY

In Italy, the WEEE Directive was transposed in 2005 with Legislative Decree 151/2005, which was followed by a series of implementing decrees. Delays in the publication of implementing decrees had a negative impact on the operation of the WEEE system.

The implementation of the WEEE Directive led, for the first time in Italy, to the creation of competitive market where producers had the opportunity to join one of several compliance schemes. Joining a compliance scheme is mandatory only for the management of household historical WEEE, arising from EEE put on market before 31 December 2010.

The creation of a competitive market necessitated the establishment of a clearinghouse (CdC RAEE) to ensure consistent operations on the part of the compliance schemes, and to ensure the proper collection and treatment of WEEE throughout the country.

All compliance schemes active on household WEEE should register with the CdC RAEE.

HOUSEHOLD WEEE (B2C)

Before the WEEE Directive came into force, household WEEE was collected along with other household waste products from municipalities and consolidated in collection sites for subsequent transfer to operators approved to treat WEEE - which was not always including disassembly, shredding and separation of the different fractions. For large appliances, retailers also offered a pick-up service, sometimes in conjunction with the delivery of the new appliance to the customer's house.

These two channels - municipalities and retailers - represent, in the text of the EU Directive, the foundation of the collection system for household WEEE.

The system coordinated by the CdC RAEE provides for the pick-up of WEEE from all collection centres that signed the contract with the CdC RAEE, including both municipal collection points and retailers. These collection centres (so-called CdR if municipal, LdR if retailers) serve as the interfaces through which the WEEE generated is collected by compliance schemes.

Table 3 – Roles and responsibilities of stakeholders in recycling chain for household WEEE

Stakeholder	ROLES AND RESPONSIBILITIES
Producers	Join a compliance scheme for management of historical household WEEE (put on market before 31/12/2010, according to national transposition). May join a compliance scheme for new WEEE.
Compliance schemes	Pick up WEEE in all collection points assigned by CdC RAEE. Deliver WEEE for treatment only to those treatment facilities accredited by the CdC RAEE. Each month, report to the CdC RAEE quantities collected.
Clearinghouse (CdC RAEE)	Ensures level playing field for all compliance schemes and uniform service levels for all collection centres enrolled in the system. Annually, assigns to compliance schemes collection points for WEEE pick-up, ensuring alignment with their market share. Monitors the quantities of WEEE collected by collection systems.
Consumers (waste holders)	Hand over WEEE to municipal collection points or retailers.
Municipal collection centres	Collect WEEE from citizens and/or retailers, divide it into five waste streams (R1-R5) and transfer it to compliance schemes for transportation to treatment plants.
Retailers	Collect WEEE from consumers (e.g. through old-for-new mechanism) and transport it to a municipal collection centre (or consolidate it in so-called LdR) for subsequent pick up by compliance schemes.
Treatment plants	Carry out treatment of WEEE handed over by compliance schemes in accordance with minimum requirements set out in agreement between CdC RAEE and Recyclers' Associations.

Compliance schemes collect WEEE from collection points and deliver it for treatment to one of the plants that is in compliance with at least the minimum standards required for accreditation by the CdC RAEE. The CdC RAEE has the right to perform mass balance at treatment plants.

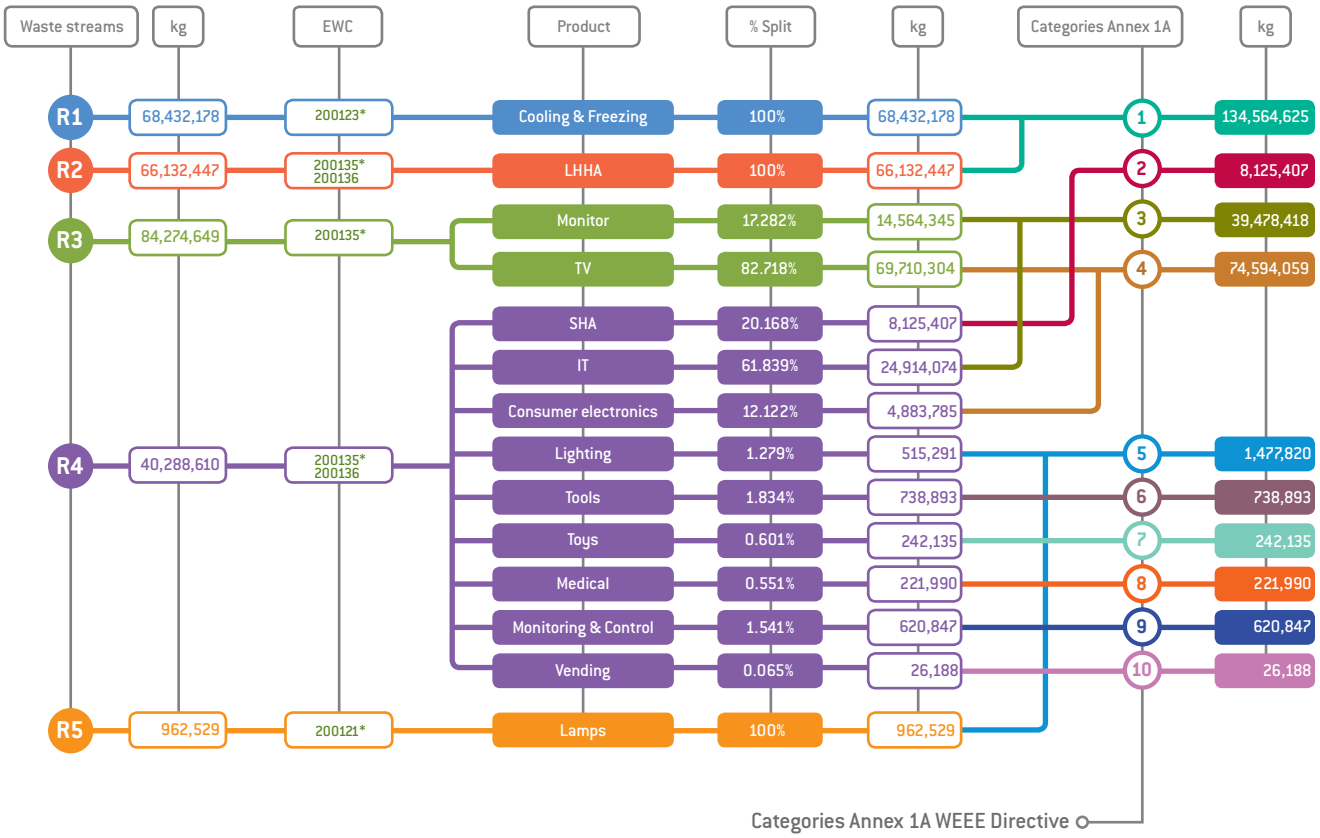
Annually, the CdC RAEE assigns collection points to compliance schemes on the basis of the previous year's market share and collection targets achieved (or not achieved) for each waste stream by each compliance scheme.

Monthly, all compliance schemes declare to the CdC RAEE the amounts of WEEE from each of the five waste streams collected from each assigned collection centre. This monthly reporting enables the calculation of WEEE quantities handled by each system and allows for corrections to be made for the following year.

National and EU-level reporting is not based on waste streams, but rather on Annex 1A EEE categories. Based on samplings carried out in different plants, the CdC RAEE annually calculates coefficients owing to split waste streams into product categories.

The breakdown of waste streams into sub-categories is necessary in particular for streams R3 and R4, as it is not possible to refer back one-to-one to product categories. Subsequent re-aggregation allows for the consolidation of the quantities managed in the 10 product categories, as required by WEEE Directive.

Figure 4 – Breakdown of waste streams into EEE categories according to the coefficients adopted in 2011

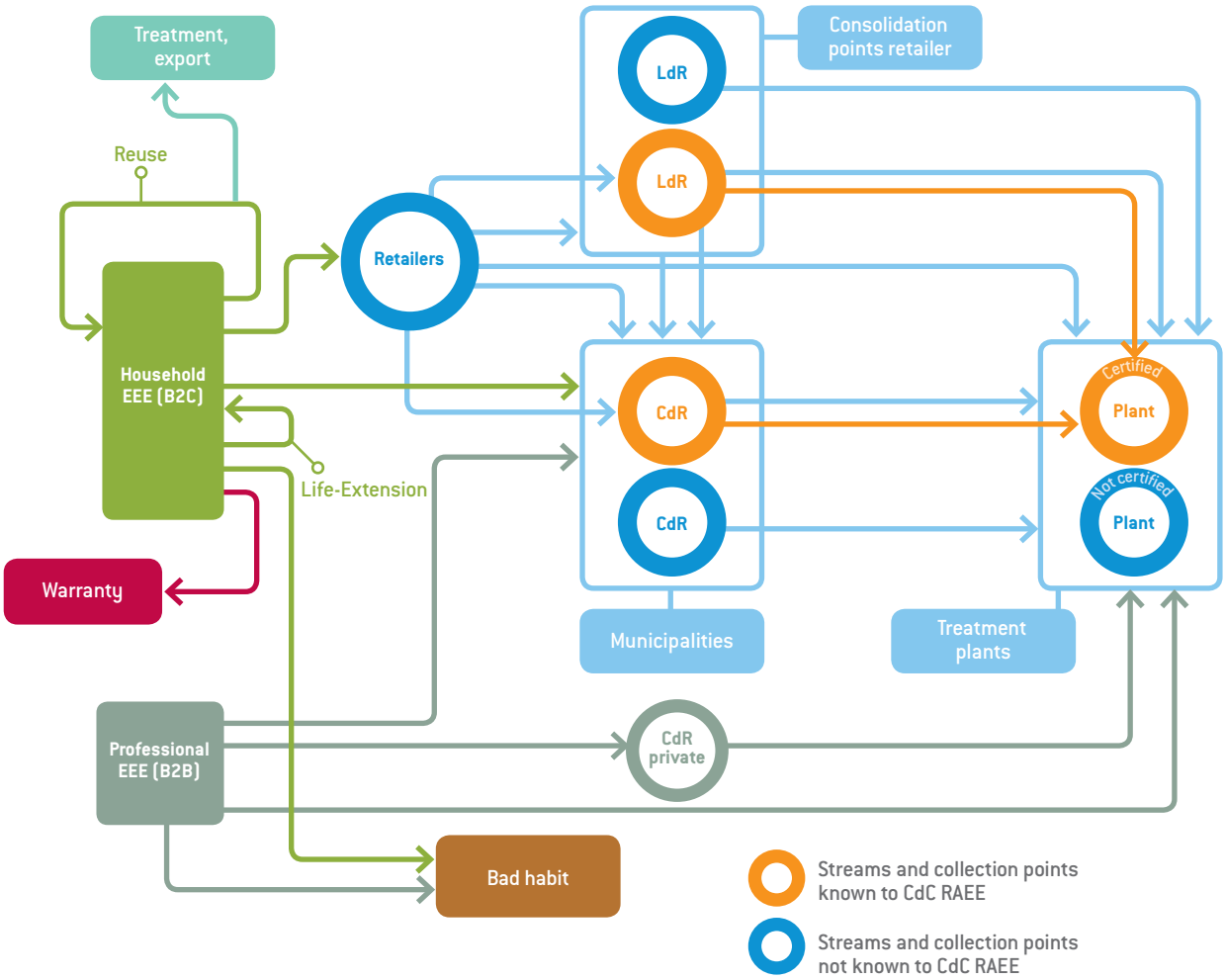


1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7. Toys, leisure and sports equipment
8. Medical devices (with the exception of all implanted and infected products)
9. Monitoring and control instruments
10. Automatic dispensers

At the national level, data provided by the compliance schemes (on behalf of all of their members) are clustered annually through the so-called Annual Environmental Declaration (MUD), analyzed by National Environmental Protection Agency (ISPRA), and subsequently reported to the European Commission. The reporting done through the MUD Declaration provides an additional level of disaggregation of streams: the European Waste Code (EWC).
All stakeholders collecting and treating WEEE are required and expected to report amounts of WEEE managed through the MUD Declaration.

The comparison between general statistics on waste management (based on EWC) and the quantity of WEEE managed (broken down by waste stream or product category) is difficult because the link between EWC and waste streams is not unique (i.e. different waste streams could have same EWC code).

Figure 5 – WEEE system in Italy: household and professional WEEE streams



PROFESSIONAL WEEE (B2B)

Before the WEEE Directive came into force, management of non-household (professional) WEEE was in most cases left to companies (waste holders) to manage according to general waste management practices, which sometimes took the form of contractual agreements with third parties who were not always responsible for the final treatment process.

After the transposition of Directive 2002/96/EC, producers are responsible for the financing of collection, transportation and treatment of professional WEEE when they supply a new, equivalent, product.

Such a system does not depend on the CdC RAEE; according to WEEE Directive legal text, waste holders and producers may sign specific agreements. Some producers use the logistics networks and treatment plants already in the networks of the compliance schemes of which they are a member, while others use alternative service providers.

Reporting of quantities handled by each producer is done exclusively through the MUD Declaration using the same procedures and requirements described for household WEEE. Quantities of professional WEEE managed by compliance schemes are not reported to the CdC RAEE for the calculation of collection performances of each scheme.

Table 4 – Roles and responsibilities of stakeholders in recycling chain for professional WEEE

STAKEHOLDER	ROLES AND RESPONSIBILITIES
Producers	Fund activities related to the management of professional WEEE (with the exceptions of supply of a non-equivalent equipment). In the case of existing bilateral agreements, producers may deliver collected WEEE to municipal collection centres. Use licensed operators to fulfil pick-up & treatment obligations.
Compliance schemes	May serve as service provider for members or third parties.
Companies (waste holders)	Hand over WEEE to producers in case of purchase of equivalent EEE, or to authorized companies with whom they signed agreement for waste management. WEEE may be handed over to municipal collection centres (subject to specific agreements and regulations at local level).
Collection points established by producers	Collect WEEE from companies and prepare it for transport to processing facilities.
Treatment plants	Carry out the treatment of WEEE.

QUANTIFICATION OF WEEE GENERATED

The volume of WEEE generated by consumers depends on a combination of multiple factors. The first step in determining the volume of WEEE arising is the analysis of historical PoM data for all EEE by product category. These devices represent the potential, in different moments of time, that will be discarded by holders through multiple channels, going to be the future stream of WEEE.

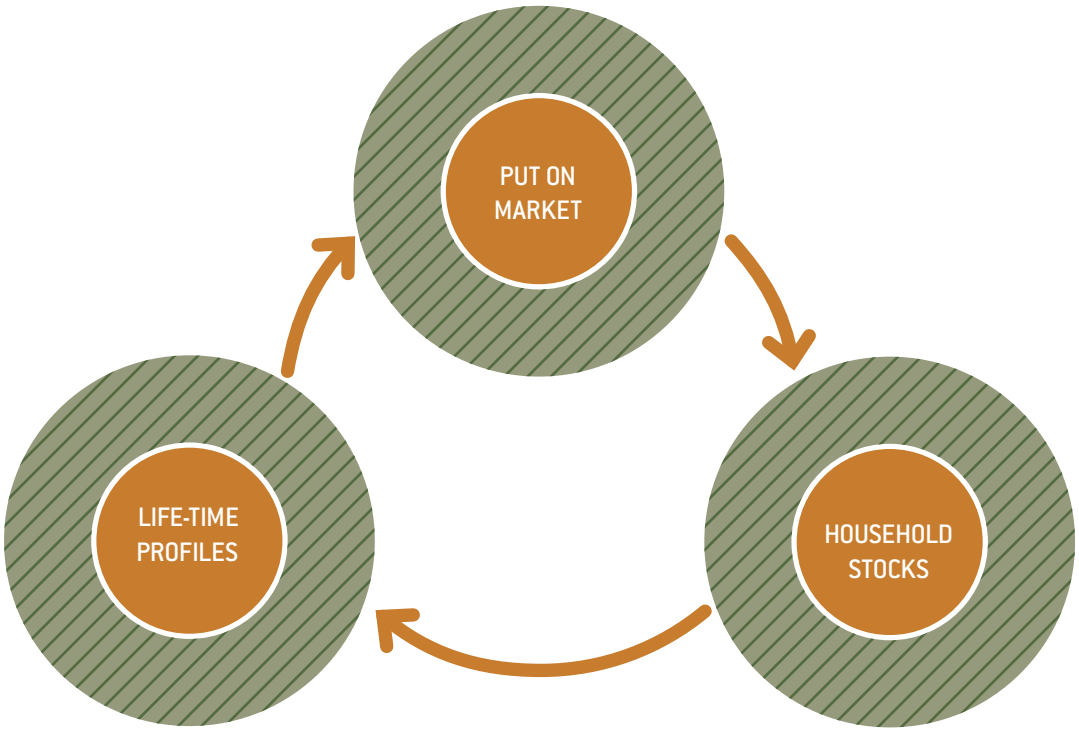
The generation of WEEE by consumers is influenced by:

- technological factors, including the need to replace EEE for mechanical or electrical failure, or for reasons of product obsolescence (e.g. the transition from analog signal to digital signal meant that some TVs were no longer compatible with the new standard). Technological factors depend on each specific EEE or the context in which EEE operates;

- social factors, such as the desire among consumers to purchase new EEE to replace existing EEE, whether to satisfy new wants or needs, or to attain new functionalities. Social factors influence the amount of time that passes between the moment EEE is no longer used and the time it is discarded (known as the hibernation period). For example, a mobile phone may not be immediately discarded due to personal or emotional factors, whereas the disposal of bulky items such as refrigerators may be delayed due to logistical factors related to their disposal. Social factors influence the choice of disposal channel, including improper disposal behaviours.

The combination of these three factors (put on market, household stocks and life-time profiles) influences the generation of WEEE by consumers.

Figure 6 – General structure of the model for estimating WEEE generated



PUT ON MARKET

Several information sources are used to calculate the amount of EEE historically put on market. Table 5 gives an overview of each source in terms of degree of accuracy and reliability, temporal coverage, completeness and accessibility.

Table 5 – Data sources used to reconstruct historical trends for EEE put on market

SOURCE	DESCRIPTION	CRITICAL ELEMENTS	ACCESSIBILITY	USED
National Register	Starting in 2006, traces EEE put on market with the level of detail defined in Annex 1B of the Legislative Decree no. 151/2005. EEE is declared in pieces and weight, with B2B/B2C data disaggregated.	Temporal coverage is limited, particularly for those products with long lifespans. Since declarations to register imply financial responsibilities, quantities put on market by free riders are not tracked.	Limited	NO
Self-declarations by producers/ compliance schemes	Starting in 2006, compliance schemes declare to CdC RAEE amount (by weight) of B2C EEE put on market by their members. Declarations are made according to specific waste stream.	Temporal coverage is limited, particularly for those products with long lifespans. Because adherence to a collection system is mandatory for management of historical WEEE, quantities of EEE put on the market by free riders are not tracked. Quantities reported are only B2C, and thus do not take into account quantities of B2B WEEE. Declarations are made (by weight) according to specific waste stream.	Limited to the compliance schemes	YES
Industrial Statistics for Domestic Production	The Italian National Institute for Statistics (ISTAT) collect on a yearly basis, structural data of industrial production, in accordance with Community provisions (which include the set of techniques, definitions and classifications to be adopted). Within these data EEE are also reported. These statistics are available from 1993 onwards.	Some codes, relating to particular products, are obscured as confidential (i.e. industries with a limited number of manufacturers or those that are considered strategically important for the country). Data include economic value and a supplementary unit that can vary from code to code (kg, pieces, or other unit of measurement). The classification of products undergoes changes in the course of time (aggregation or disaggregation of existing codes or the introduction of new ones). In 2006 a total re-coding of products occurred.	Public	YES
Trade Statistics for Import and Export	ISTAT detects quarterly or monthly economic value and amount of trade with foreign countries in accordance with Community provisions. Such surveys include also EEE. Correspondance between Combined Nomenclature and Prodcom is established at Community level. These statistics are available from 1993 onwards.	The values are always specified value and a supplementary unit that can vary from code to code (kg, pieces, or other unit of measurement). Changes in classification are possible but less frequent than in the case for Prodcom codes.	Public	YES

SOURCE	DESCRIPTION	CRITICAL ELEMENTS	ACCESSIBILITY	USED
Industry associations	The main industry associations (ANIE, ANIMA, CECED, ANITEC, etc.) report annually on the market and sometimes on the penetration of specific products. These statistics are available from the early 1990s depending on the type of equipment.	Generally the surveys distinguish the products most representative of the category.	Restricted to members of industry associations	YES
Market research experts	Surveys and analysis of market statistics are usually carried out by specialized institutions, with the aim to evaluate the market and the penetration of specific products.	Generally surveys include only few products (fewer than couple of dozens).	Generally purchased for a fee. Partially available	YES
National Institute for Statistics (ISTAT)	ISTAT's annual multipurpose surveys cover a broad range of topics, including the market penetration and household use of some appliances. The statistics relating to certain products are available from the early 90s onwards.	The findings, although conducted on a very large sample of families (19,000 families in 2011, for a total of almost 48,000 individuals), cover only a few (10) products.	Public	YES

With the aim to reconstruct historical trends for all types of EEE put on market, all available sources have been taken into account. Primarily data from Industral production statistics and trade statistics (import and export) has been taken into account. Where necessary has been reconstructed information not available in one source with data available in another source; for all series, gaps or inconsistencies between different sources have been carefully evaluated.

For large appliances with long lifespans, the quantity of appliances put on market in the 1980s was estimated on the basis of considerations of market trends. These devices continue to account for a share (albeit a rather small share) of WEEE generated today.

An in-depth survey conducted by IPSOS on a sample of Italian families identified products representing different categories of EEE (so-called "UNU-KEYS"). For these products, the stock, stock age and average age of discarded WEEE have been investigated. This information, properly weighed, allows for the validation of the information obtained from the sources described above as to the historical trends for all categories of EEE put on market.

INTERNATIONAL STATISTICS

Multiple codes exist in order to identify goods and products in macro-economic statistics. The main difficulty is to identify those codes corresponding to EEE and, in particular, EEE falling within the scope of the WEEE Directive.

These codes have been carefully identified during the research. For each specific code, domestic production, imports and exports for the years between 1993 and 2011 have been derived and calculated where information was not available due to confidentiality of national statistics.
For each code, values were derived based on three criteria: economic value, quantity and weight. This analysis also allowed for the evaluation of changes in the average weight of the products in the various categories over time.
Total EEE put on market was then derived according to the following equation:

Put on market (PoM) = domestic production + import – export

Table 6 provides an example, for 2011, of the total number of codes from PRODCOM and the Combined Nomenclature used in international statistics, as well as the subset of those codes identified for EEE, broken down by waste stream (R1-R4).

Table 6 – Codes from PRODCOM and Combined Nomenclature identified and used in 2011

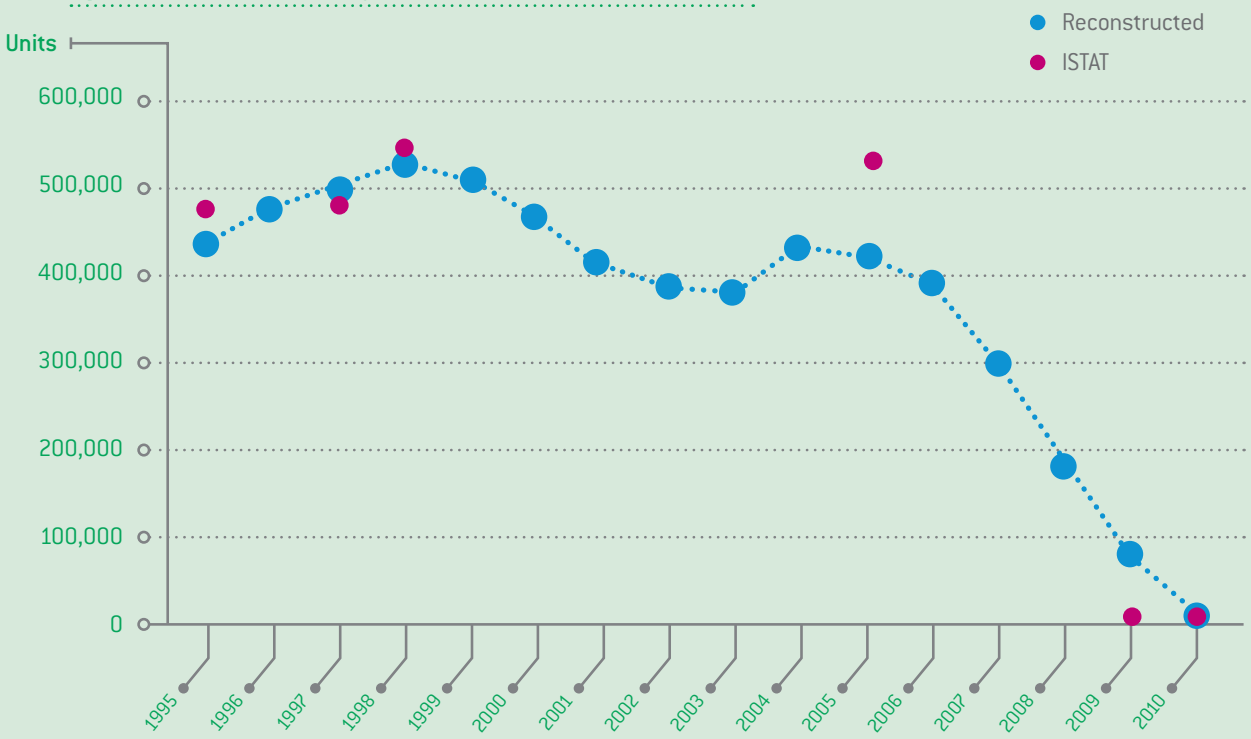
	Numbers of entries in 2011	Included in the analysis (related to AEE)	Related to R1	Related to R2	Related to R3	Related to R4
PRODCOM	>9,400	165	12	19	6	128
CN	>3,800	345	21	29	11	284

EXAMPLE: DATA RECONSTRUCTION FOR MICROWAVE OVENS

National statistics for domestic production of microwave ovens (Former Prodcom 29.71.27.00, re-coded from 2008 onwards to 27.51.27.00) are only available for a limited number of years (1995, 1997, 1998, 2005, 2009 and 2010) due to confidentiality restrictions imposed by ISTAT on the data from other years.

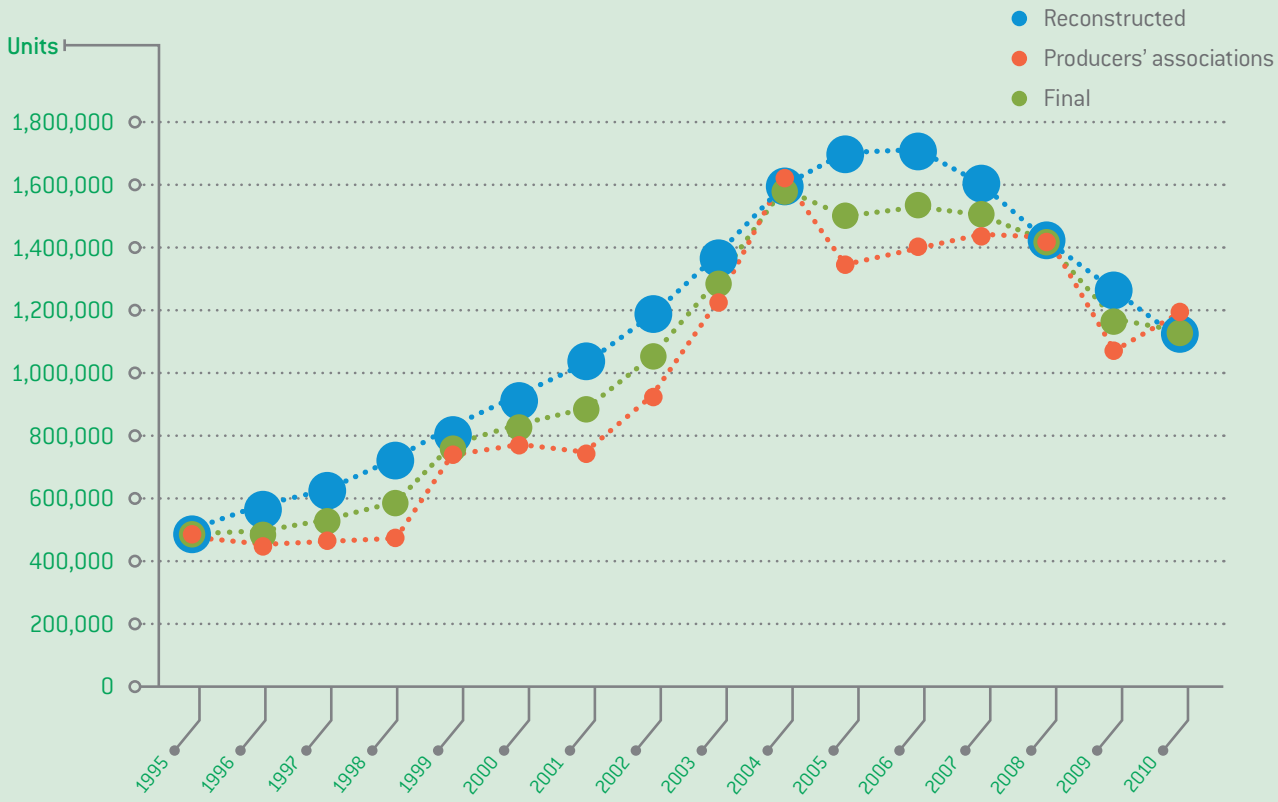
The reconstruction of the series of production is obtained from the known data and on the basis of the total set of confidential codes for each year. Aggregates of confidential data were appropriately dis-aggregated taking into account export value. The result of the model used has provided as an output the series of domestic production shown in Figure 7.

Figure 7 – Reconstruction of initial production data for domestic microwave ovens



Data on domestic production were combined with data on imports and exports in order to generate a data series for microwave ovens put on market during the years in question. The output was subsequently compared with data available from producer associations in order to obtain a more complete data set, as shown in Figure 8. The data was then expanded to cover the years prior to 1995 in order to be used in the forecasting model for WEEE generated described in the next chapter.

Figure 8 – Complete reconstructed data for microwave ovens put on market



UNU-KEYS

Streams of EEE are extremely diverse and complex, both in the range of products and in the terminology associated with the various products. The same can be said of the types of waste arising from these products (WEEE or e-waste), although from a treatment technologies perspective they can be grouped into a limited number of categories (waste streams). UNU-KEYS, the system used to classify the different types of WEEE, was developed to allow both the functionality and the waste characteristics/disposal requirements of products to be taken into account. This classification system ensures consistency in the categorization and analysis of both EEE PoM and EEE stocks in efforts to quantify WEEE generated and waste streams.

There are 58 UNU-KEYS categories representing classes of products with similar functionality and that exhibit similar characteristics in the waste stream. Some UNU-KEYS categories include single products (e.g. washing machines, laptop computers or cell phones), while others include more extensive product classes (e.g. body care equipment or portable audio/video equipment).

Of the 58 UNU-KEYS categories, 25 have been identified as most important, given their weight/volume, their economic value and/or environmental impact. UNU-KEYS include all possible EEE, thus allowing for both big-picture and category-specific analyses of the waste stream.

Each UNU-KEY category is associated with one of the product categories outlined in Annex 1A and 1B of the WEEE Directive, is categorized as either professional (B2B) or household (B2C), and is included in one of the five waste streams and the 17 sub-categories used in the preparation of the WEEE Forum Key Figures.

Each of the UNU-KEYS is also dynamically linked to (annual) statistics on international production (Prodcom) and international trade (Combined Nomenclature) of EEE in order to make possible the quantification of historical EEE put on market and the creation of historical data series.

Table 7 – TOP 25 UNU-KEYS

UNU-KEY	Description	Waste stream (Italy)
102	Dishwashers	R2
103	Furnaces and ovens	R2
104	Washing machines	R2
105	Wash dryers + centrifuges	R2
108	Fridges (without freezer)	R1
109	Freezers	R1
110	Combi-fridges	R1
114	Microwave ovens	R2
201	Mixed small household appliances	R4
204	Vacuum cleaners	R4
302	Desktop computers	R4
303	Laptop computers (incl. notebooks and tablets)	R4
304	Printers, scanners and multifunction printers	R4
306	Mobile phones and smartphones	R4

UNU-KEY	Description	Waste stream (Italy)
308	CRT monitors	R3
309	Flat screen monitors (LCD, plasma, LED)	R3
402	Portable audio/video devices (e.g. MP3 players, e-readers, etc.)	R4
403	Radio and HiFi equipment	R4
404	VCRs and DVD players	R4
407	CRT TVs	R3
408	Flat screen TVs (LCD, plasma, LED)	R3
502	Compact fluorescent lamps, LEDs	R5
504	Linear fluorescent tubes (B2B)	R5
509	Luminaires	R4
602	Small domestic tools	R4

WEEE FORUM AND KEY-FIGURES

The WEEE Forum is the European association of 41 compliance schemes active in WEEE take-back and recycling. Founded in 2002, the WEEE Forum aims to promote the sharing of best practices between the various Member States in order to optimize the management of WEEE. One of the association's activities is the Key-Figures survey, which collects data on the quantities of WEEE collected and treated annually by all WEEE Forum members, as well as the total costs of the supply chain, including costs related to the functioning of compliance schemes. Data are collected at the sub-category level (17 product sub-categories), allowing for precise analysis of waste streams.

TIME SERIES: EEE PUT ON MARKET

Figure 9 shows the historical trend in the amount of EEE put on market in Italy, including both B2B and B2C EEE.

Figure 9 – Historical trends in household (B2C) and professional (B2B) EEE put on market in Italy (kg/inhabitant), excluding lamps

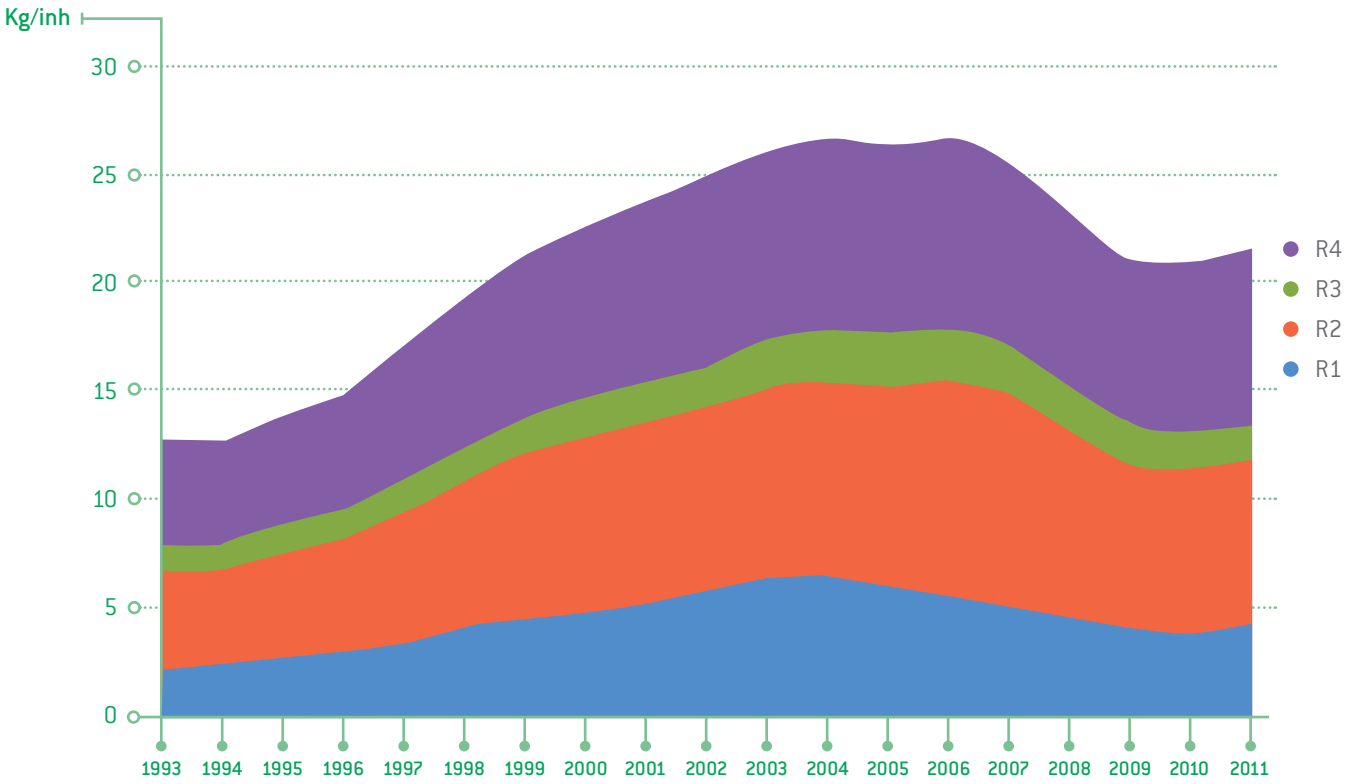


Table 8 shows the amount of EEE put on market in 2011, broken down by waste streams and B2C/B2B. It also shows the amount of household EEE stocks in 2012, expressed in kg/inhabitant per waste stream, as calculated by the model described in the following sections.

Table 8 – Household (B2C) and professional (B2B) EEE put on market in 2011 and average household stocks of EEE in 2012, per waste stream (kg/inhabitant), excluding lamps

	R1	R2[2]	R3	R4	Total
B2C EEE PoM (2011)	2.99	6.84	1.50	6.97	18.30
B2B EEE PoM (2011)	1.30	0.58	0.34	1.05	3.27
Total EEE PoM (2011)	4.29	7.42	1.84	8.02	21.57
Household EEE Stocks (2012)	51.2	88.6	22.3	53.0	215.1

2 Includes central heating and non-electric heating systems, as it is not possible to differentiate in Prodcom and CN statistics

EEE STOCKS AND LIFE-TIME PROFILES

IPSOS SURVEY

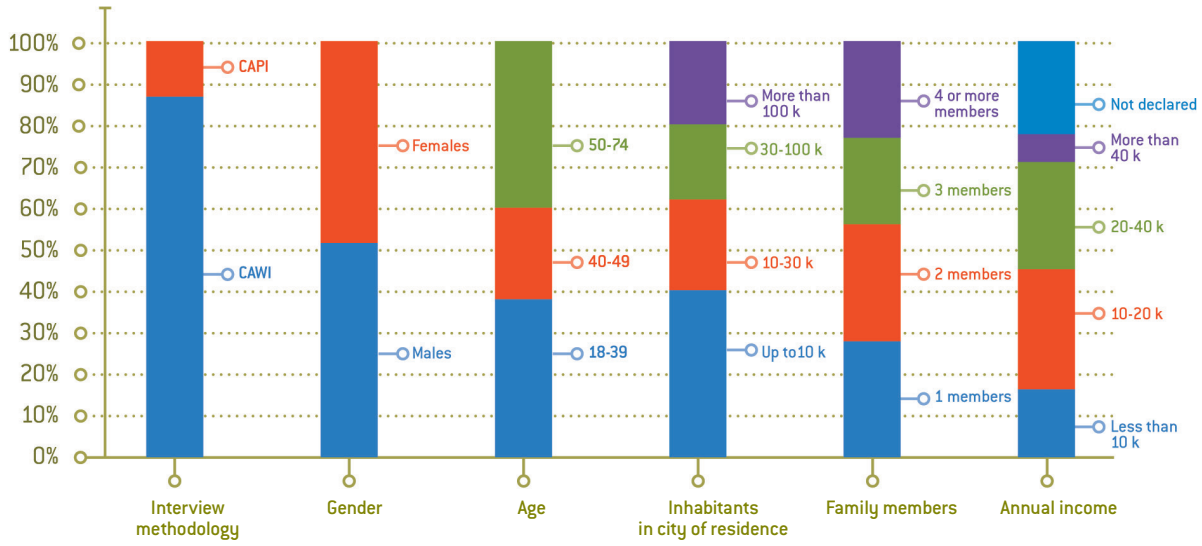
In order to complete the prediction model for WEEE generated, a research survey was conducted by IPSOS with the aim of quantifying "life-time profiles" and "stocks" of EEE. The IPSOS survey had two specific objectives:

- to identify and quantify household stocks of EEE, particularly:
  I. number and types of products in household stocks
  II. number of products in use
  III. number of products no longer functional but still at home
  IV. number of products that are operational but no longer in use
  V. whether EEE is new or used
  VI. age of EEE

- to identify main disposal behaviours and channels, particularly:
  I. age of EEE at time of disposal
  II. disposal channels used
  III. purchase of equivalent or replacement EEE before or after disposal.

In terms of methodology, the IPSOS survey used both a web-based, self-completed questionnaire (CAWI), which was completed by 2,854 individuals between the ages of 18 and 55, and a face-to-face questionnaire (CAPI), which was completed by 408 individuals between the ages of 35 and 74. By combining the two methodologies (CAWI and CAPI) and surveying different but overlapping age ranges, the IPSOS survey was able to reach segments of the population that are under-represented on the Internet (older-age, less-educated, from small- to medium-sized towns) and to verify information gathered and address distortions or discrepancies in the data. Furthermore, more populous regions were over-sampled and the entire sample was segmented according to various socio-demographic characteristics.

Figure 12 – Breakdown of survey's participants



Central to the survey was the concept of ownership of EEE by survey respondents or their families and how ownership affects attitudes and behaviours related to the disposal of WEEE. The survey also gathered information on factors such as whether the EEE was used in respondents' primary residences, rental houses or houses/apartments rented to third parties, and whether the EEE was acquired second-hand or as a gift.

The choice of products (EEE) included in the questionnaire was based on the identification of representative products within the different UNU-KEYS. Priority was given to the UNU-KEYS included in the "TOP 25", though other products were also included in order to complete the other categories. In the identification of UNU-KEYS (e.g. importance of the specific UNU-KEY 205 as compared to the total EEE), and of individual representative products to be selected (e.g. razors/epilators, hair dryers or electric toothbrushes compared to other products in the same UNU-KEY 205), were considered the relevance on the basis of benchmarking with literature and international sources, taking into account put on market amounts, stocks in households and occurrence in the waste stream.

The categories included in the survey cover close to 90 per cent for household products. The selection process has led to the identification of 61 representative products, as reported in Table 9. The selection process also helped to identify coefficients in order to re-proportion to the entire EEE data set the answers of surveys carried out on the sample of 61 products in order to generalize the results obtained from the questionnaire.

Table 9 – EEE used in IPSOS questionnaire

UNU-KEY	Products included in the IPOSO Survey	Relevance
001	Electric Boilers (excluding gas)	2.1%
102	Dishwashers	4.6%
103	Electric cooktops, built-in or stand-alone ovens, stand-alone kitchens with integrated oven	2.6%
104	Washing machines, washer-dryers	12.3%
105	Dryers	3.7%
106	Hoods	1.8%
108	Fridges (fridge only)	5.3%
109	Freezers	3.3%
110	Combination fridges-freezers (combi)	4.1%
111	Fixed air conditioners (outdoor unit), portable air conditioners	0.4%
114	Microwave ovens	2.8%
201	Irons, table or support fans (excluding ceiling)	2.5%
202	Toasters, fryers, blenders, mixers, grinders, electric grills	4.9%
203	Kettles, coffee machines	1.8%
204	Vacuum cleaners	1.9%
205	Electric shavers, epilators, hairdryer, electric toothbrushes	0.5%
301	Keyboards, mouse	1.9%
302	Desktop PCs (excluding monitors and other accessories)	2.9%
303	Laptop computers, including notebooks and netbooks (excluding accessories)	1.2%
304	Printers & multifunction printers (with print/copy/scan capabilities)	3.1%

UNU-KEY	Products included in the IPOSO Survey	Relevance
305	Landline phones, including wireless (cordless)	0.1%
306	Mobile phones	0.2%
308	Cathode Ray Tubes (CRT) monitors	2.7%
309	Flat panel monitor (LCD, plasma, LED), tablets (e.g. iPad)	2.2%
401	Headphones	0.5%
402	Mp3 players, audio/video equipment, navigation systems	0.3%
403	Stereos, integrated systems (including amplifier, CD player, radio), amplifiers	2.7%
404	VCRs, DVD players, digital TV/Satellite TV equipment	2.0%
405	Speakers	1.3%
406	Digital cameras, camcorders	0.2%
407	CRT TVs	4.4%
408	Flat screen TVs (LCD, plasma, LED)	3.1%
509	Lighting appliances, excluding light sources (e.g. light bulbs)	1.6%
602	Drills, slectric lawn mowers, sewing machines, high pressure cleaners	1.9%
702	Games and consoles to be connected to a display (e.g. Xbox, Playstation), handheld gaming devices (e.g. Nintendo DS)	0.2%
703	Electric pianos	0.1%
Total		87.2%

In order to determine the size of household stocks of EEE, all respondents were asked how many electrical or electronic products they owned. Accurate household stock data is crucial to validate the time series of EEE put on market. In order to ensure high quality responses, the questionnaire was limited in length. Questions were selected according to the following criteria:

- of total current EEE stocks held by respondents, 20 products were randomly selected for questioning in order to evaluate average age of stock, as well as whether the items were in use or not working, whether they were obtained new or used, etc. A maximum of four items within the same product category were chosen;

- of total current EEE stocks held by respondents, 30 products were randomly selected in order to assess product age and disposal methods.

The results from the survey, in particular with regards to the assessment of overall stocks of EEE in Italian families, were subsequently expanded to take into account socio-demographic characteristics of the Italian population, as measured by ISTAT. In particular it was found statistical correlation between parameters of the sample and particularly: number of household members, age, house property.

THE MODEL

The IPSOS survey data, in particular the average age of household EEE stocks and the average age of discarded WEEE, enabled the construction of life-time profiles for each UNU-KEY included in IPSOS survey. These distributions express the probability that EEE placed on the market in a given year is disposed of by the consumer through one of the disposal channels highlighted in the questionnaire. Life-time profiles were obtained by

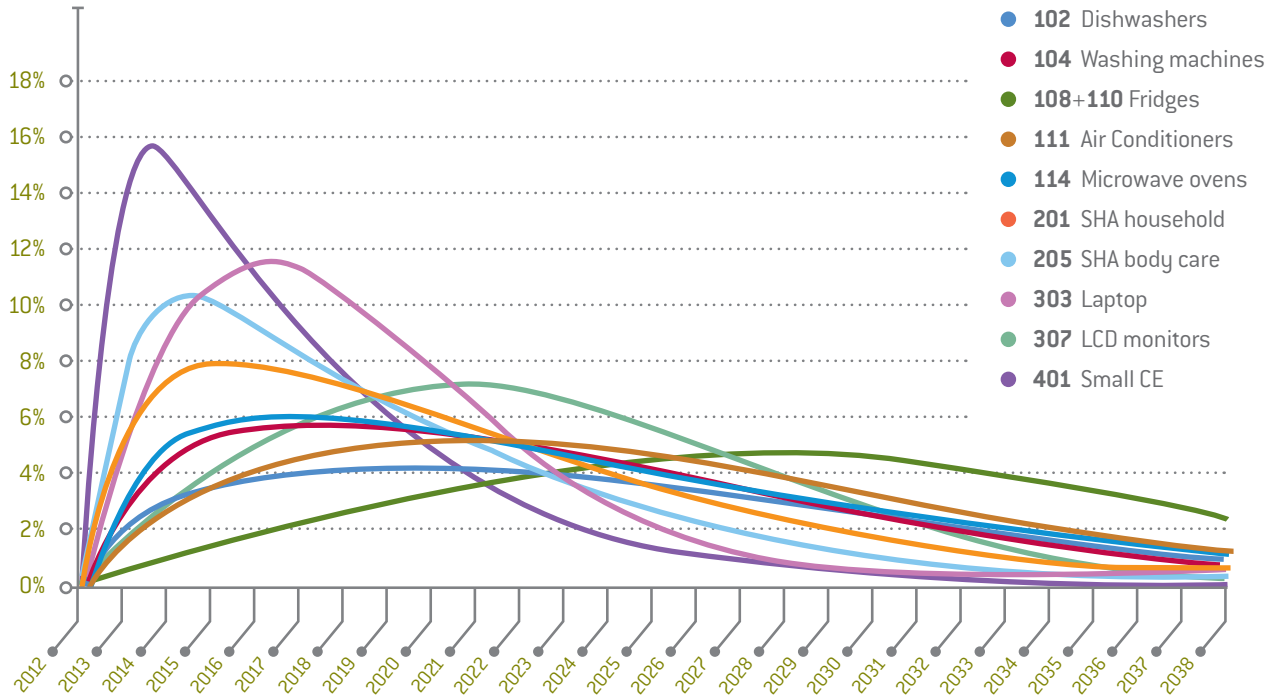
combining the age of EEE stocks and the age of WEEE disposed of by consumers. Such distributions assume, mathematically, the form of the Weibull function, with parameters of scale (lambda) and shape (kappa). The scale parameter, which is associated to the average life of EEE, was made to vary in time according to a shift parameter: such variations explain the lengthening or the shortening of the life-time of EEE put on market in the past with respect to those put on market in recent years.

The life-time profiles for each UNU-KEY were then correlated with the EEE PoM data and 2012 household stocks, as assessed by means of IPSOS survey. For some specific types of EEE, the use of other complementary data sources enabled the correlation of data for other years, as well.

Each UNU-KEY has been developed through the use of a mathematical model that accounts for the convergence between the three pillars of the model already described in Figure 6: EEE put on market, household stocks and life-time profiles. This convergence models a fundamental equation that underlies the approach to the calculation of WEEE generated: consumers, at different moments in time, because of a combination of technological and social aspects, decide to dispose of portions of their household stocks of EEE using various disposal channels and methods. A portion of this stock has accumulated in their houses over time as a result of the purchase of new or used EEE.

Figure 13 shows, as example, the life-time profiles for some UNU-KEYS (relevant for 2012). These probability distributions, applied to EEE placed on the market in 2012, gives the probability of disposal in future years. In each reporting year, the overall share of WEEE generated is given by the sum of the contributions of all previous years.

Figure 13 – Example of life-time profiles for selected UNU-KEYS put on market in 2012



As can be seen in Figure 13, different products have different life-time profiles, as well as different sector dynamics, which means that put on market (PoM) and WEEE generated (WG) values also vary across different products. Figure 13 allows for some general considerations about the implications of the life-time profiles on the model of target-setting used:

- EEE with medium-to-long life-time profiles influence to a lesser extent the generation of WEEE than EEE with shorter life-time profiles do in years immediately after they were put on market. Correlation between PoM and WG varies per product.

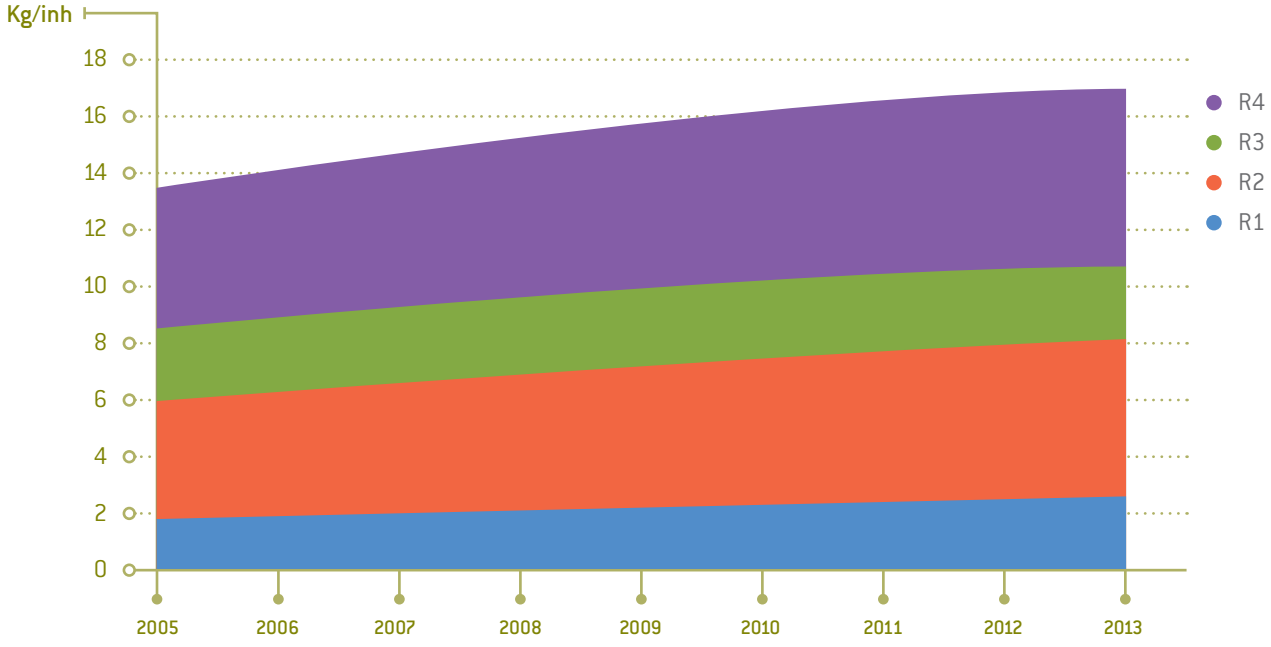
- The pattern of EEE with medium-to-long life-times becoming WEEE generated at a slower rate than EEE with short life-times is even more pronounced for EEE with higher average weight (Large Household Appliances). In such contexts, there is a substantial "independence" of the generation rate of waste from put on market in recent years; such aspect is further accentuated as these EEE are in most cases characterized by saturated markets.

- For EEE with either relatively short life-time profiles, or being new in the market, the generation of WEEE is more difficult to predict and potentially much lower in the immediate years due to lower market saturations. An example is LCD TV's which are, unless damaged beyond repair, moving to another room within a household, or to another household replacing CRT TV's.

THE RESULTS

Using the time series data of EEE put on market, life-time profiles and household stocks, obtained as described in the previous paragraphs for each UNU-KEY, it is possible to estimate the average household WEEE generated, as shown in Figure 14.

Figure 14 – Household WEEE generated (2005 - 2013), per waste stream (expressed in kg/inhabitant)



In this figure, the projection on future years is limited to 2013. Assuming a stable growth of the market in the years 2012 and 2013, however, the impact of WEEE generated as a direct consequence of EEE put on market in 2012 and 2013, including both items that are discarded within the first two years of life and those that serve as replacements for equivalent EEE, is extremely limited.

When comparing Figure 9 (EEE PoM) and Figure 14 (WG, albeit limited to domestic origin), it can be seen that, despite the substantial decline in the market in recent years due to the macro-economic downturn, the rate of generation of WEEE is still growing constantly. This effect is linked to the inertia of the generation process (i.e. sales of past years are influencing more than sales in recent years the WG).

Such inertia also has an important effect on target setting strategy. As Table 10 shows:

- total WEEE generated represents overall 88 per cent of the average annual EEE put on market over the previous three years. In some cases, however, this ratio is greater than 100 per cent, as in the case of markets in strong contraction, such as the market for cathode ray tube equipment, which is no longer being placed on the market but is being disposed of as it is replaced by newer technologies (e.g. LCD);

- targets based on EEE PoM are considerably lower than targets based on WG, which reflects the effects of the economic downturn in recent years. Such a phenomenon is typical of the inertia described above.

Table 10 – Household WEEE generated, per waste stream (2011)

	R1	R2	R3	R4	Total
Household WEEE generated 2011 (kg/inh)	2.40	5.18	2.86	5.86	16.30
Average household PoM 2008-2010 (kg/inh)	2.95	6.15	2.29	7.12	18.51
WG on PoM (2008-2010)	81%	84%	125%	82%	88%
Target 65% PoM	1.9	4.0	1.5	4.6	12.0
Target 85% WG	2.0	4.4	2.4	5.0	13.8

It is important to emphasize that the target, as indicated in Table 2, should be considered in conjunction with complementary streams, as described below.

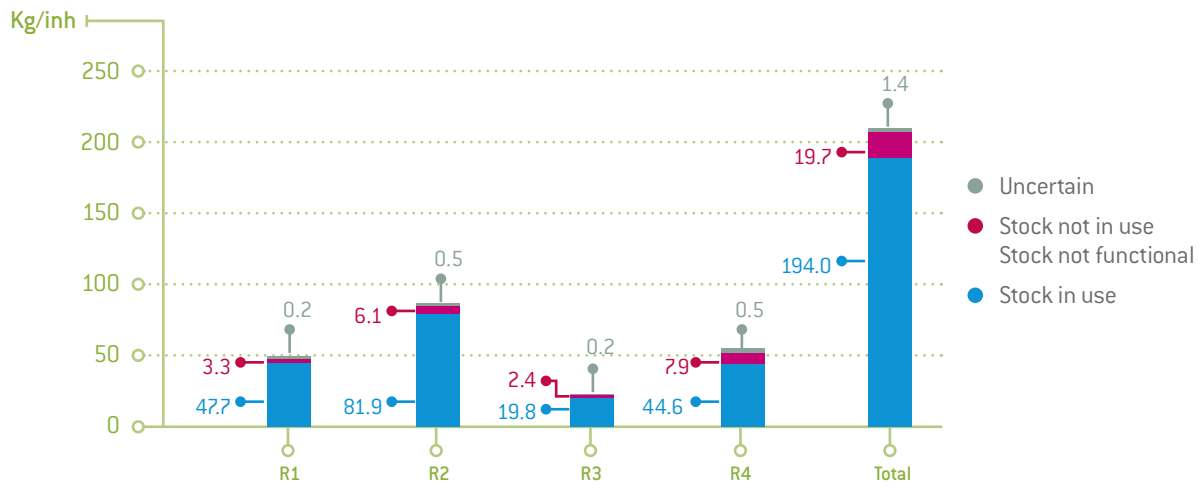
HOUSEHOLD WEEE STREAMS

The IPSOS survey emphasized the characterization of EEE and consumer behaviours, particularly with respect to EEE possession and disposal pathways. This information provides more elements for comparison of different approaches to target setting (PoM compared to WG), as it is directly related to the generation of WEEE streams.

EEE STOCKS AND WEEE POTENTIAL

The first set of IPSOS survey questions focused on a random sample of 20 products currently or previously possessed by respondents. These data were then used to evaluate household EEE stocks, to validate the time series data and to estimate WEEE generated. Respondents were asked if their EEE items were in use, no longer in use but still functioning, or no longer functioning. The responses showed that over 13 per cent of household EEE stocks is made up of equipment no longer in use, including both functional and no-longer-functioning equipment.

Figure 15 – Household stocks of EEE and WEEE in 2012 (kg/inhabitant)



These findings, as detailed by waste stream in Figure 15, suggest some important considerations:

- in Italy, a hibernation period exists for appliances falling into the category of "potential WEEE" (EEE not working or no longer in use, but which has not yet been discarded). This phenomenon may be attributable to consumer behaviour dynamics, such as lack of awareness of how to properly dispose of WEEE (especially small ones), perceptions of residual product value, emotional attachment, or organizational or logistical factors linked to WEEE disposal;

- this hibernation phenomenon is more pronounced for WEEE in R4 streams, but there are variations between products, even within the same waste stream. For example:
  - from 3 per cent of fridges up to 11 per cent of air conditioners in R1
  - from 2 per cent of washing machines up to 21 per cent of dryers in R2
  - from 1 per cent of the flat-screen TVs up to 38 per cent of CRT monitors in R3
  - from 5 per cent of laptops up to 24 per cent of game consoles in R4.

Overall, the amount of WEEE hibernated as stock in Italian households in 2012 represents a significant volume, especially in terms of the potential re-entry of their raw materials into the economic cycle.
These elements also show how a target based on EEE put on market may be adversely affected by habits of consumers. Even in saturated markets where products are purchased as substitutes for out-of-use or no-longer-functioning products, old equipment is often not discarded for a variety of reasons.

DISPOSAL PROCESS BY CONSUMERS

Analysis of disposal processes included a random sample of 30 products submitted to each respondent. For each product, respondents were asked whether, at any point in the past, they had disposed of WEEE from the different categories, and whether the disposal had taken place within the past year. According to the survey data, 72 per cent of subjects had never disposed of certain types of WEEE in the past.

Figure 16 – Total WEEE discarded

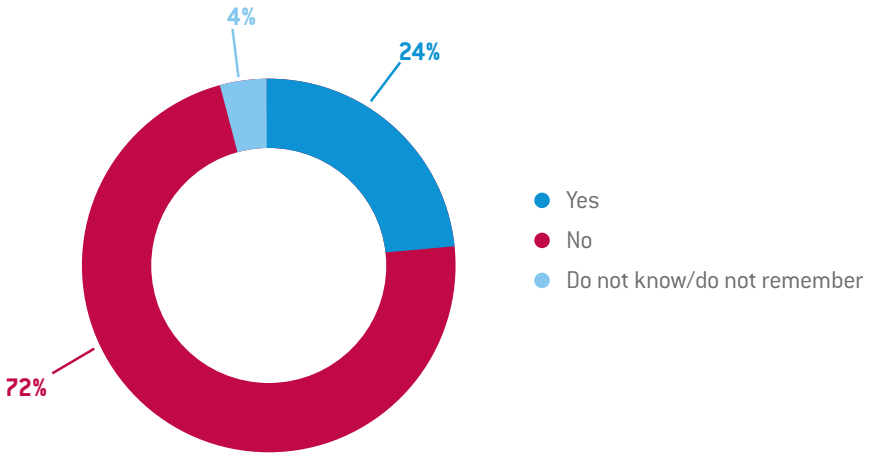


Table 11 provides a breakdown of the results by waste stream. The analysis highlights how, within each waste stream, UNU-KEYS more disposed exist. In particular fridges and dishwashers for R1 and R2. In waste stream R3, the disposal of CRT products by consumers has been accelerated by the switch to digital terrestrial technology. In R4 small products prevail.

It is important to stress, however, that some products are replaced very infrequently. This is typical for products in growing markets, such as air conditioners (R1) and flat screens (R3), and may apply to long-life products such as dryers (R2).

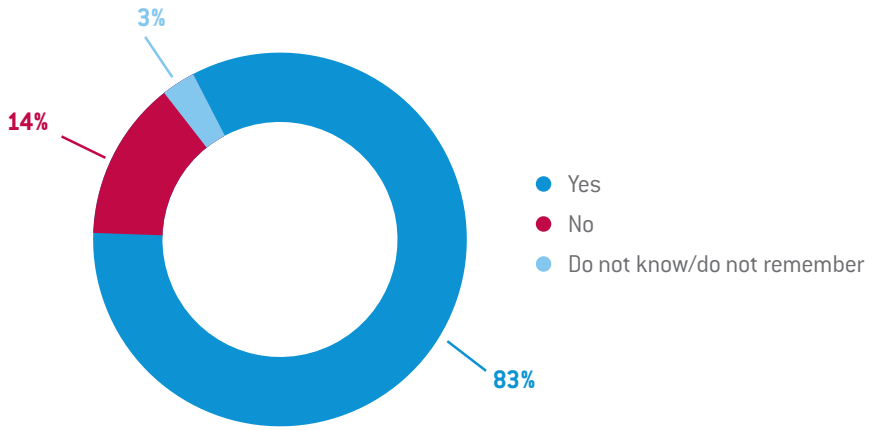
In such cases, the potential discrepancy between a targets based on EEE put on market and WEEE actually generated can be significant.

Table 11 – Disposal of WEEE: analysis by waste stream and significant appliances

	R1	R2	R3	R4	Total
Yes	33%	31%	19%	23%	24%
No	63%	65%	78%	73%	72%
Do not remember/do not know	4%	4%	3%	4%	4%
Totale	100%	100%	100%	100%	100%
UNU-KEY mostly disposed (% respondents who disposed)	**108+110** Fridges (47%)	**104** Washing machines (61%)	**407** CRT TVs (54%)	**306** **Mobile** phones (49%); **201** SHA households (43%)	
UNU-KEY less disposed (% respondents who never disposed)	**111** Air conditioners (91%)	**105** Dryers (90%)	**408** LCD TVs (93%); **309** LCD monitors (89%)	**406** Digital cameras (92%); **402** Portable audio/video (90%); **403** Hi-Fi (87%); **405** Speakers (87%)	

Respondents were also asked if their disposal of WEEE coincided with the purchase of equivalent or replacement products. As Figure 17 shows, no replacement purchase occurred in 14 per cent of cases.

Figure 17 – Purchases of equivalent EEE within 6 months of disposing of old WEEE



Analysis of the data at the waste stream level (detailed in Table 12) highlights some other important considerations:

- for products from saturated markets or products that are part of essential household stocks, there is a high probability of purchase of equivalent EEE in the case of disposal. This is the case of large appliances like fridges (R1) and washing machines (R2), and for small household or personal appliances (R4). However, it is also the case of products which, though they are in expanding markets (such as that of LCDs), represent consolidated technological standards;

- some products in growth markets, however, are not replaced with an equivalent product for various reasons related to individual consumer experience. For example, some products may no longer be needed or may be considered unnecessary, while others may not meet consumers' expectations or feature preferences, or may not meet the changing needs of families. This is often the case for air conditioners (R1), dryers (R2), and small consumer electronics and portable audio/video devices;

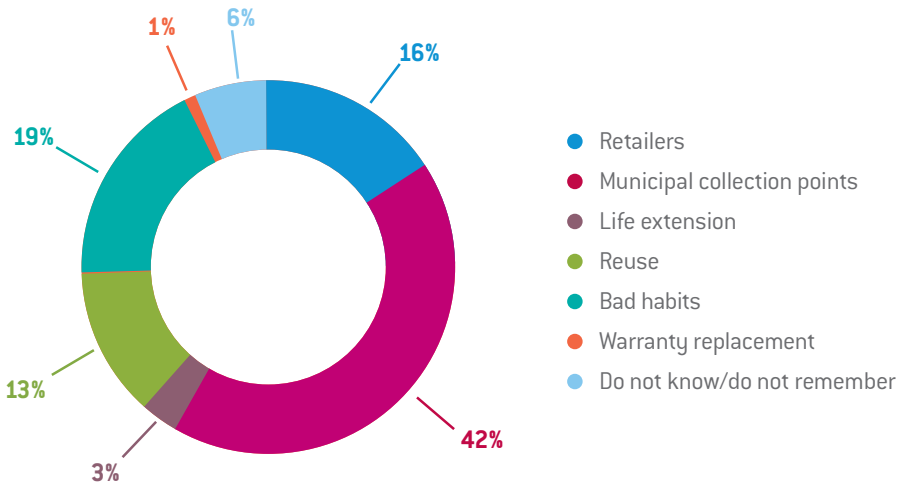
- while the markets for some products are in decline (e.g. CRT TVs and monitors), these products might anyway have been replaced in past years with same products. Again, this is due to consumer experiences and preferences, such as preference for a particular product or technology.

Table 12 – Purchases of equivalent EEE within 6 months of disposing of old WEEE: Analysis by waste stream and significant appliances

	R1	R2	R3	R4	Total
Yes	88%	88%	70%	82%	83%
No	10%	10%	29%	15%	14%
Do not remember / do not know	2%	2%	1%	3%	3%
Total	100%	100%	100%	100%	100%
UNU-KEY most replaced on disposal (% respondents who purchased)	**108+110** Fridges (91%)	**104** Washing machines (91%)	**408** LCD TVs (90%)	**201** SHA Households (87%) **205** SHA body care (86%)	
UNU-KEY less replaced in the event of disposal (% respondents who did not buy)	**111** Air conditioners (33%)	**105** Dryers (40%)	**407** CRT TVs (34%) **308** CRT monitors (32%)	**401** Small CE (35%) **402** Portable audio/video (34%)	

Therefore, it is again important to note that not always there is a correspondence between put on market and the effective generation waste, or that, in any case, there are different behaviors at waste stream level but sometimes also for EEE belonging to the same stream.
All respondents were asked what disposal methods they used for different products that they discarded in the past. These options were grouped into seven clusters, as shown in Figure 18.

Figure 18 – WEEE disposal method: analysis in pieces



This figure represents average consumer habits, though it does not break down such habits by waste stream. Such information, however, is important for the development of effective intervention strategies. Table 13 presents waste stream-level disposal data. The following are some key findings from the data, as shown in Table 13:

- for large household appliances (R1 and R2), the two main disposal paths are through municipal collection points and retailers. For large household appliances in waste stream R1, about 25 per cent

were disposed of through retailers and 22 per cent were disposed of through municipal collection points;

- WEEE in waste streams R3 and R4 are primarily disposed of through municipal collection points;

- for large household appliances there is a significant amount of equipment left in old houses. This equipment falls into waste stream categories R3 and R4;

- a significant percentage of equipment is sold or given away for re-use:
  - on average, 9 per cent of products in waste stream R1 are sold or given away for re-use, with limited variation between products within the waste stream;
  - in R2, 8 per cent of products are sold or given away for re-use, though re-use rates for products within the waste stream varies considerable, from 1.5 per cent for boilers up to 20 per cent for microwave ovens;
  - An average of 16.5 per cent of products in R3 are sold or given away for re-use, including 13 per cent of CRT products, on the low end, and 30 per cent of flat screens, on the high end;
  - The percentages of products in R4 that are sold or given away for re-use varies greatly, from 1.5 per cent of body care products up to more than 50 per cent of video games, with an average of 14 per cent;

- a significant percentage of WEEE is disposed of improperly. The likelihood of improper disposal practices appears negatively correlated with the size of the equipment, meaning that smaller products are more likely to be disposed of improperly. For equipment belonging to waste stream R4 (mostly small products), a higher number of respondents report that they do not remember which disposal channel they used. Such aspect identify a need for greater awareness about the proper disposal of such waste.

Figure 13 – Example of Life-time profiles for selected UNU-KEYS put on market in 2012

	R1	R2	R3	R4	Total
Retailers	43.4%	37.1%	13.3%	10.1%	16.0%
Municipal collection points	37.1%	39.1%	57.8%	42.5%	42.1%
Life extension (old house, ...)	4.6%	5.3%	1.8%	2.9%	3.3%
Reuse	9.0%	8.0%	16.5%	14.0%	12.9%
Bad habits (e.g. waste bin, plastic waste, other wrong streams, ...)	3.3%	5.8%	8.0%	22.3%	18.4%
Warranty replacement	0.1%	0.6%	0.1%	0.9%	0.8%
Do not know/do not remember	2.5%	4.1%	2.5%	7.3%	6.5%
Total	100%	100%	100%	100%	100%

By combining the data on the disposal channels used by consumers with estimates of WEEE generated, it is possible to estimate the breakdown of WEEE streams by weight for each UNU-KEY category. Figure 19 shows the aggregate distribution of WEEE streams, by weight (kg/inhabitant), using the estimated volumes in 2011. Notable findings include:

- Municipal collection points remain the most important collection channel, capturing over 44 per cent of the total WEEE generated.

- Retailers are the second most important channel, capturing 25 per cent of the total WEEE generated.

- Roughly 13 per cent of appliances is re-used, though that number rises to 16 per cent when incorporating the life extension values.

- Improper disposal accounts for 10 per cent, by weight, of WEEE generated.

Figure 19 – WEEE disposal method, by waste stream: total streams, by weight, in 2011

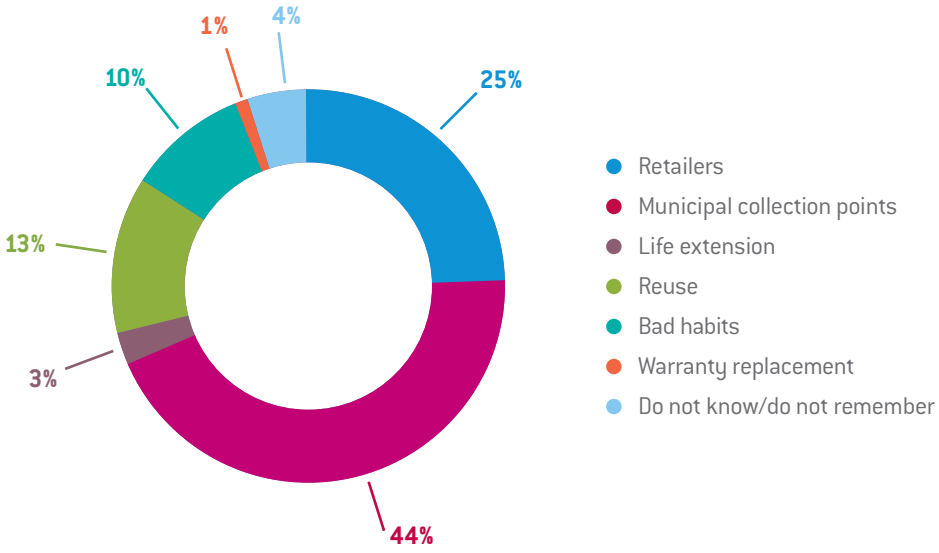


Table 14 presents the average amount of WEEE, by weight (kg/inhabitant), that consumers dispose of through the various disposal channels. Key findings include:

- retailers and municipal collection points accounted for roughly equal shares of WEEE collected from waste streams R1 and R2. There is also consistency in the ratio of such streams: R1 account for nearly 1/3, while R2 for reamining 2/3 of the large household appliances (R1 & R2). The WEEE in these waste streams comes from largely saturated markets (in most cases), which is consistent with EEE put on the market data (see Table 8);

- municipal collection points account for the majority of WEEE collected from waste streams R3 and R4;

- of the 1.6 kg/inhabitant of WEEE improperly disposed of, the majority (one kg/inhabitant) comes from waste stream R4.

Table 14 – WEEE disposal method, by waste stream: total streams, by weight, in 2011[3]

	R1	R2	R3	R4	Total
Retailers	0.9	2.0	0.4	0.7	4.0
Municipal collection points	1.0	2.0	1.7	2.5	7.2
Life extension (old house, ...)	0.1	0.2	0.1	0.2	0.6
Reuse	0.2	0.4	0.5	1.1	2.1
Bad habits (e.g. waste bin, plastic waste, other wrong streams,...)	0.1	0.3	0.2	1.0	1.6
Warranty replacement	0.0	0.0	0.0	0.1	0.1
Do not know/do not remember	0.1	0.2	0.1	0.4	0.7
Total	2.40	5.18	2.86	5.86	16.30

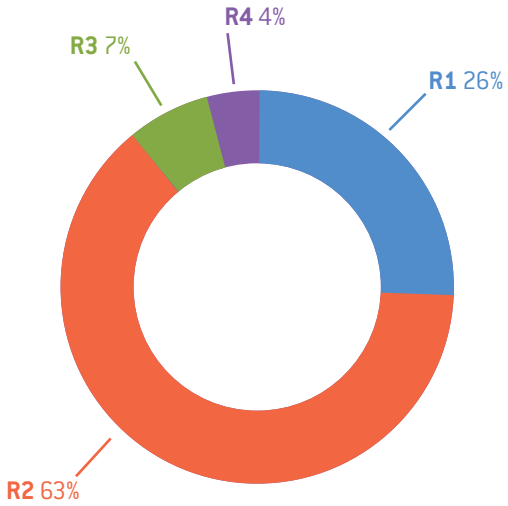
3 Totals do not take into account decimal rounding.

Retailers

In order to analyze in more detail the WEEE streams collected by retailers and compare them with the results of the IPSOS survey, the research team collaborated with AIRES (Italian Association of retailers selling EEE), an association of about 1,800 Italian companies and other groups that specialize in household appliances and consumer electronics distribution, to design a survey to gather the necessary data on quantities of WEEE generated and collected for each UNU-KEY in 2011, including the amount of WEEE handed over by consumers at retailers or picked-up by retailers at consumers' homes. Although the survey was conducted on a limited number of members, it nevertheless enables some important insights into aspects of WEEE disposal and collection patterns.

The breakdown of the total WEEE collected (Figure 20) shows how retailers are particularly important collection points for large household appliances (R1 and R2). The survey data is consistent with the data from the IPSOS Survey regarding the disposal of WEEE in waste stream R1, which represents about one third of the total large appliances collected by retailers. The number of devices collected from waste streams R3 and R4 is considerably lower.

Figure 20 – Distribution of total WEEE collected by retailers, by units collected



A more detailed analysis in Table 15 shows that there are significant differences between the devices returned directly to retailers and those picked up by retailers at consumers' homes:

- large household appliances (R1 and R2) are picked up at consumers' homes 75-95 per cent of the time, often in conjunction with the delivery of new equipment. However, smaller household appliances (e.g. microwave ovens) are more likely to be returned at retailers;
- WEEE in waste stream R3 is returned in to retailers at roughly the same frequency as it is picked up at consumers' homes;
- for WEEE in waste stream R4, a significant majority of products are turned in to retailers, though the total volume of WEEE turned in from waste stream R4 remains relatively small compared to the other waste streams.

Table 15 – WEEE turned in to retailers and collected from consumers' homes (per cent of total units collected)

Stream expressed in units	Breakdown % (years 2011-2012)	Average share returned by the consumers at the Point of Sale	UNU-KEY products conferred more	Average share of pick-up by retailers at consumers' homes	UNU-KEY products most withdrawn
R1	26%	5 – 25%	**108+110** Fridges	75 – 95%	**108+110** Fridges
R2	63%	5 – 25%	**104** Washing machines **103** Furnaces & ovens **114** Microwave ovens	75 – 95%	**104** Washing machines **102** Dishwashers **103** Furnaces & ovens
R3	7%	40 – 60%	**407** CRT TV **408** Flat panels	60 – 40%	**407** CRT TV **408** Flat panels
R4	4%	90 – 95%	**306** Mobile phones **304** Printers **201** SDA Households	10 – 5%	N.D.
Total		10 – 20%		80 – 90%	

It must be noted, however, that only a fraction of WEEE collected from retailers was subsequently managed by the formal WEEE system (CdC RAEE) in 2011:

- In 2011, there were just over 60 retailers (or retailer consolidation points) where compliance schemes provided WEEE pick-up service. These retailers/collection points accounted for a total of only 12,000 tonnes of WEEE collected, less than five per cent of total WEEE managed in Italy. The number of retailers subscribing to such compliance schemes rose in 2012, reaching anyway around one hundred collection points;

- A survey conducted in 2011 by ANCI and CdC RAEE on a sample of 325 collection points, representing 46 per cent of the population served by CdC RAEE, showed that only 7.6 per cent of the total WEEE collected by collection points was delivered by retailers.

There is therefore a need to track complementary streams, which would ensure consistency in the overall system of reporting.

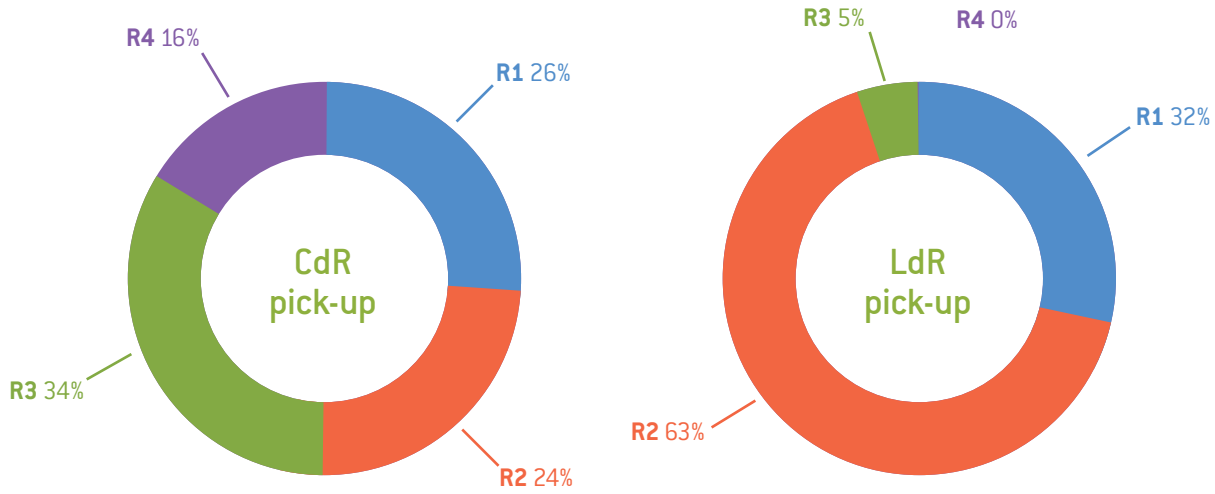
Municipal collection points

In comparing WEEE quantities collected by the CdC RAEE in 2011 with quantities collected by retailers, the following patterns emerge:

- The CdC RAEE collected similar amounts of WEEE, by weight, from waste streams R1 and R2 from municipal collection points. Pick-ups from retailers' show on the other hand consistency between the R1/R2 ratio as reported by consumers and retailers.

- Estimation of WEEE generated in 2011, split on different channels, as shown in Table 14, sees a substantial consistency between the suggested mathematical model and actual performances of CdC RAEE. Particularly good matches between the model and actual performance occurred in waste streams R1 (1 kg/inhabitant predicted by the model and 1.1 kg/inhabitant collected by the CdC RAEE) and R3 (1.7 kg/inhabitant estimated by the model and 1.4 kg/inhabitant collected by the CdC RAEE). Larger gaps between the model and actual WEEE collected by the CdC RAEE occurred for waste streams R2 (2 kg/inhabitant estimated the model and 1.1 kg/inhabitant collected by the CdC RAEE) and R4 (2.5 kg/inhabitant estimated by the model and 0.7 kg/inhabitant collected by the CdC RAEE).

Figure 21 – Breakdown of WEEE streams (R1-R4) managed by the CdC RAEE in 2011. Pick ups from municipal collection points (CdR) and from retailers (LdR)

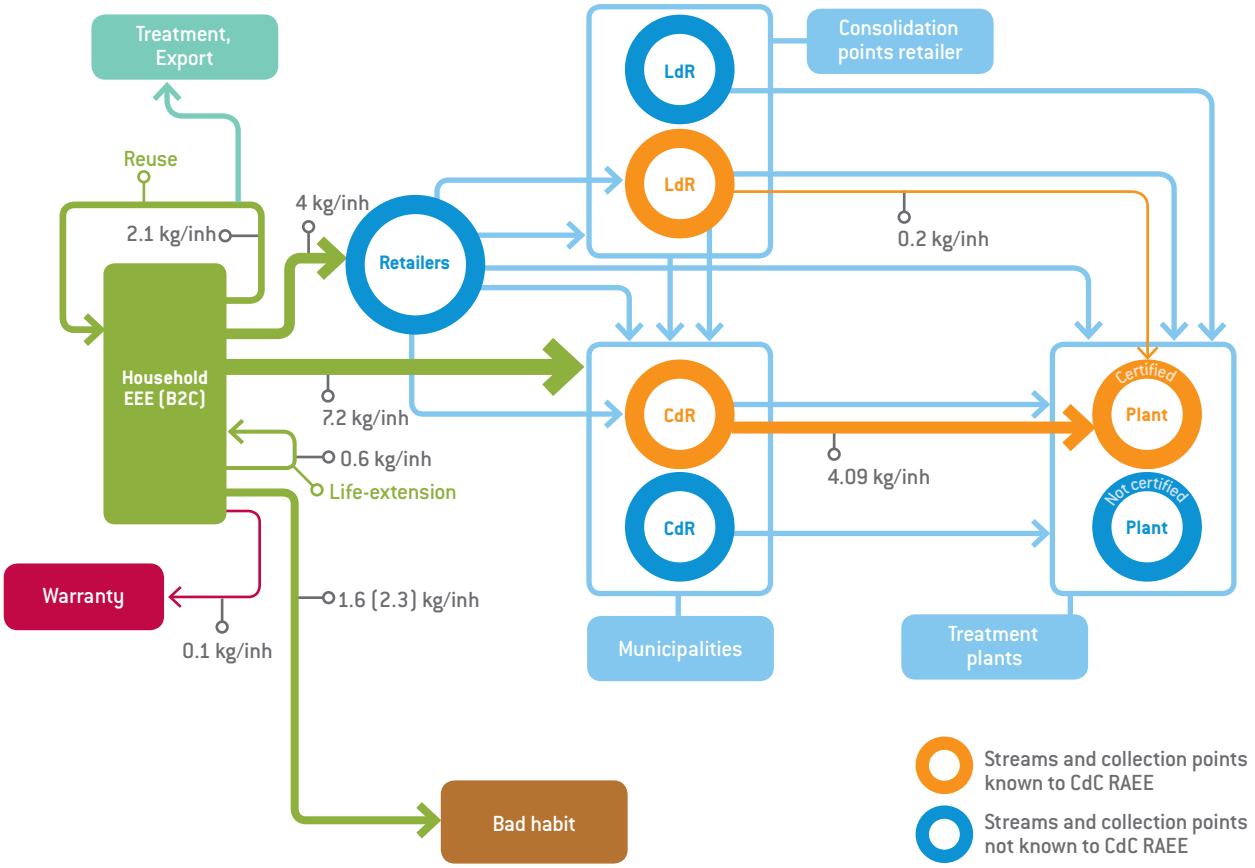


Once again, the data on WEEE collected by collection points makes clear the need to trace complementary waste streams, particularly R2 and R4, to improve consistency in the overall reporting system.

COMPLEMENTARY STREAMS

Analyses carried out on WEEE generated and disposal paths used by consumers, as well as evidences of actual performance of formal WEEE system in 2011 allows for the formulation of some general conclusions, as shown in Figure 22.

Figure 22 – WEEE system and complementary streams



The formal WEEE system ensures collection and treatment only for those streams handed over to compliance schemes by the retailers and municipalities. In 2011 amount of WEEE managed by the system reached 4.29 kg/inhabitant, of which 0.2 kg/inhabitant was directly picked-up from retailers.
This stream represents only part of total WEEE generated in Italy, which was estimated to be 16.3 kg/inhabitant in 2011.

Even this total, however, does not account for WEEE hibernating in households, as detailed in Figure 15. Of all WEEE generated in Italy, much of it is:

- Disposed of improperly. WEEE is often discarded with other waste streams and ends up in landfills or undergoing other inappropriate treatments. In 2011, this stream of improperly disposed of WEEE was estimated at 1.6 kg/inhabitant, though it could be as high as 2.3 kg/inhabitant, given the level of uncertainty on the part of survey respondents (consumers). Improper disposal is especially prevalent for WEEE belonging to waste stream R4. Indeed, 62 per cent of all improperly disposed of WEEE comes from waste stream R4. In total, 17 per cent of the WEEE generated in waste stream R4 is disposed of improperly. It is very difficult for the formal WEEE system to intercept these streams of improperly disposed of consumer WEEE, though failure to do so could undermine the overall performance of the formal WEEE system in Italy.

- Disposed of by consumers through re-use channels. Of all WEEE generated, 12.9 per cent (by weight) is sold or given away for re-use, including through the internet, accounting for a total of 2.1 kg/inhabitant. Some of these products are refurbished and later re-enter the market; 8.5 per cent of WEEE generated is purchased, inherited or received as a gift according to IPSOS survey. The remaining WEEE disposed of through re-use channels (0.7 kg/inhabitant) is exported or sent to treatment. There is little likelihood of intercepting and treating streams exported abroad as used EEE.

- Sent by retailers and municipalities directly for treatment, without the intervention of the compliance schemes. For WEEE collected by retailers according to "simplified" procedures defined in DM 65/2010, direct hand-over to treatment plants is feasible only if the treatment plants are also registered as collection sites according to DM 65/2010. These streams are complementary streams by definition. The quantification of this contribution is only possible after annual waste declaration has been performed by all companies, as required by MUD, and published by ISPRA. This share is a significant proportion of the total amount of WEEE collected through the two channels, amounting to an estimated 11.2 kg/inhabitant in 2011.

At greater risk of "leakage" from the formal WEEE system to complementary streams is WEEE belonging to waste streams R2 and R4. This phenomenon of leakage is largely due to the progressive growth in recent years of the economic value of WEEE. However, it is important to highlight that economic value is related to three factors:

- a favourable economic situation in the market for secondary raw materials (especially metals and plastics), which has benefitted treatment plants;

- progressive specialization and optimization of treatment processes, in particular for waste stream R4, which ensures greater purity of fractions recovered, and which enables greater enhancement of fractions in downstream markets;

- processing overcapacity, at least in certain geographical areas. The gradual establishment of "concentrations of capacity" have stimulated a progressive and increasing competition between treatment plants to secure WEEE for treatment.

The risks associated with these factors are high. Listed below are some of the primary concerns:

- The progressive growth of competition for access to WEEE can trigger a progressive lowering of quality standards for treatment. This risk is particularly pronounced in cases where the conditions listed above change.

- The WEEE system, through the agreement with the main recyclers' associations, ensures that all streams managed by compliance schemes are treated only in certified plants. This guarantee does not exist for complementary streams. Data on exports of WEEE (and components) of the Special Waste Report 2011 published by ISPRA show that, in 2009, compared to approximately 2,500 tonnes of WEEE from households exported (mainly in Germany and Austria), there are over 110,000 tonnes of professional exported (mainly in China and Pakistan).

- As outlined in the introductory paragraphs, significant discrepancies exist in the consistency and frequency of reporting between the formal WEEE system and complementary channels. Only timely and consistent monitoring of all those involved in the collection and treatment chain can guarantee greater control on the part of authorities with respect to the overall performance of the Italian WEEE system and increase the likelihood of achieving WEEE collection targets.

CONCLUSIONS

DEFINITION OF COLLECTION TARGETS

The definition of a target setting system requires consideration of some important data on WEEE streams.

- In 2011, household EEE put on market amounted to 18.3 kg/inhabitant (21.6 kg/inhabitant including professional EEE). The three year average of EEE put on market from 2008-2010 amounted to 18.5 kg/inhabitant. The 65 per cent put on market (65% PoM) collection target is thus 12 kg/inhabitant.

- In 2011, household WEEE generated amounted to 16.3 kg/inhabitant. The 85 per cent WEEE generated (85% WG) collection target is thus 13.8 kg/inhabitant.

- The formal WEEE system collected and treated 4.29 kg/inhabitant in 2011. This represents 35.8 per cent of the PoM target of 12 kg/inhabitant, and only 31.1 per cent of the WEEE generated target of 13.8 kg/inhabitant.

- Improper disposal, including uncertainty from consumers, of WEEE accounts for roughly 14 per cent of WEEE generated, which significantly undermines the performance not only of the formal WEEE system and the ability of Italy to meet its collection targets.

- Of the total WEEE generated in 2011, 12.9 per cent (2.1 kg/inhabitant) is sold or given away for re-use, though only 1.4 kg/inhabitant (8.6 per cent of WG) are actually re-used. The remaining 0.7 kg/inhabitant are exported as used EEE or sent elsewhere for treatment as WEEE. In addition to the 2.1 kg/inhabitant sold or given away for re-use, another 0.6 kg/inhabitant (3.7 per cent of WG) is left by consumers in old houses. Together, these streams represent 16.6 per cent of the total WEEE generated. Proper accounting of such streams is necessary, reducing where necessary the overall quantity of WEEE generated in target definition.

- Complementary streams from municipal collection points and retailers represent a significant share (68.7 per cent) of the total WEEE generated, though these streams are not directly documentable until annual declarations have been made by all parties involved. MUD declarations for 2011 will take place in 2012 and data will be available in 2013. Should be anyway noted that in 2011, the formal WEEE system was able to collect only 38.3 per cent of these streams, which amounts to a mere 23.2 per cent of WEEE generated. It is essential to ensure full traceability of all these complementary streams if Italy is to meet its collection targets.

FUTURE OUTLOOK

This study, the first of its kind in Italy, sheds light on several important trends, issues and phenomena related to WEEE generation, monitoring and collection in Italy. The information and insights in this report will prove useful in developing strategies for achieving Italy's collection targets set by the new WEEE Directive. Listed below are some key developments covered in this study:

- historical data for EEE put on market, based on a careful analysis of national and international statistics, has been derived. The identification of Prodcom and CN codes for each UNU-KEY will facilitate monitoring & control of specific EEE categories, as well as place checks on free riders, by enabling the comparison with the data reported to the National Register;

- life-time profiles have been created for each UNU-KEY and stocks of EEE in Italian households. The comprehensiveness and utility of these profiles can be improved by expanding the sample and extending the survey to professional EEE.

This study also allows for detailed analyses of individual product types (UNU-KEYS), though the comprehensiveness of such analyses will be affected the quality of the data available for particular product types. Improvement in the quality and consistency of data across product would enable more comprehensive analyses that could support the policies, financial planning and technology development for the treatment of specific types of WEEE.

In order to track changes in consumers' WEEE disposal behaviours, the size and state of household EEE stocks, and the share of household appliances that are or are not in use, consumer surveys should be repeated on a regular basis.

These elements represent the starting point for a more accurate estimate of WEEE generated, which is necessary in order to develop a target setting system capable of:

- Taking into account the market dynamics of the different types of EEE, at least at the waste stream level, as requested in Article 5 of the new WEEE Directive.

- Taking into account consumers' habits and modes of disposal, a key moment between the generation of waste and its entry into the waste stream. Such insight offers the real possibility of channelling this often-missed waste through a proper system of collection and treatment.

- Being updated dynamically, as additional information, data and evidence are gathered, thus allowing for real-time adjustments and improvements to optimize strategies for achieving not only the collection targets outlined in the dictates of the new WEEE Directive, but with the high collection rates already achieved by other European countries.

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DISCLAIMER

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