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Final

Impact of glass from cathode ray tubes (CRT) in achieving the WEEE recycling and recovery targets



From 15 August 2018, waste electrical and electronic equipment (WEEE) containing screens are classified as category two: “screens, monitors, and equipment containing screens having a surface greater than 100 cm²”. From this date onwards, Member States shall ensure that producers meet the following minimum targets for this category¹:

- 80 % shall be recovered, and
- 70 % shall be prepared for re-use and recycled;

This paper provides a WEEE Forum analysis of the current market situation and the difficulties in achieving the recycling and recovery targets for category two (screens).

Main message

Displays containing cathode ray tubes (CRT) stopped being put on the market at the beginning of this century. However, twenty years later, CRT displays still represent a significant part of the WEEE collected under category two. It is estimated that in the year 2020 still 2.400.000 tons of CRT's will be present in Europe in households and companies that would need to be treated (EERA). The share of glass containing lead in CRT tubes is close to 35% in weight. Finding an appropriate recycling destination for WEEE CRT glass is crucial in achieving the recycling and recovery targets stated by Directive 2012/19/EU on WEEE. Sadly, there are not enough technologies and facilities that currently ensure proper recycling of CRT glass. This situation gives rise to stockpiling, compliance issues and environmental, health and safety issues.

- *The WEEE Forum calls on legislators and policymakers to harmonise the way in which they classify CRT glass and to agree what the recycling, recovery and disposal solutions for WEEE CRT glass are.*
- *Regulations need to align with currently available recycling solutions for CRT glass.*
- *Competent authorities should urgently stimulate the development of recycling and recovery solutions that address the existing problems around CRT glass.*

Why CRT displays are an issue of concern

Screens illustrate the evolution in production and consumption of electronics and are one of the most dynamic product categories (ProSUM Final Report, 2017). For electronic displays (mainly monitors and TVs) there has been a big shift from CRT type monitors and TVs to flat panel displays. This shift in technologies entails a shift in the type of screens collected as waste. Flat (LCD, LED, OLED...) screens are currently replacing CRT screens in the WEEE stream. More flat screens are purchased per household; however, the average weight of a CRT display is notably higher than the average weight of a flat screen. Due to the shift of technologies, less and less CRT displays are being collected every year, however they still represent the majority in weight of category two; a survey conducted by WEEE Forum in 2016² estimated that flat screens represent less than 30% of the weight collected under category two, in many countries this percentage is even lower; the most frequent answer among respondents was a range from 0% to 10%. This means that a relevant amount of CRT displays is still in stock and being collected as WEEE.

¹ Category 2 comprises appliances such as screens, Televisions, LCD photo frames, Monitors, Laptops, Notebooks.

² Survey with 16 respondents providing estimated data from 14 different EU countries (DK, CY, BE, NL, GR, ES, SE, PT, FR, RO, AT, IE, CZ, PL). Members from 10 countries responded that the share of flat screens is between 0%-10%. “Responsible recycling of CRT screens” (EERA, 2018) provides an average value of 15% of the weight of flat screens for TVs and monitors.

On average, 60%³ of the weight of a CRT display is glass. Simply speaking, there are two types of glass in a CRT tube:

- panel or front glass (approximately 65% of total glass) and
- funnel or back glass (approximately 35% of total glass).

The content of lead of the funnel glass makes it difficult to find an appropriate recycling solution for it. According to Empa, a CRT display may contain between 1 kg and 1.5 kg of lead.

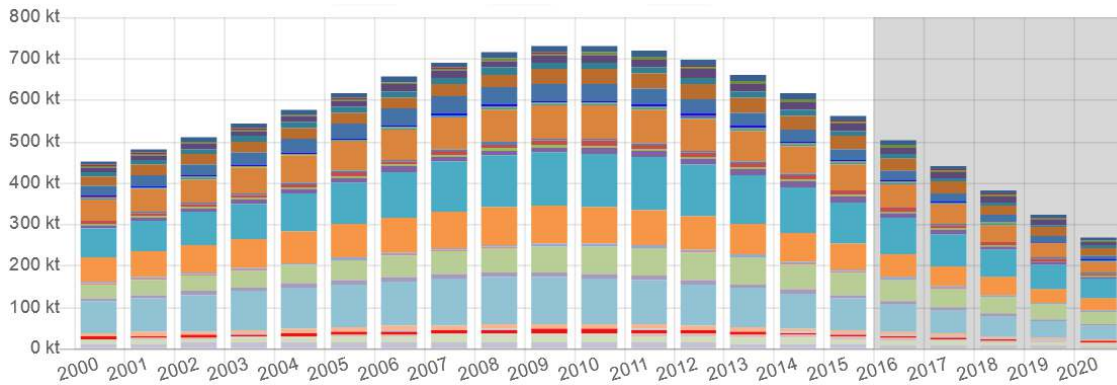


Figure 2. CRT displays generated in EU. Estimate provided by the Urban Mine Platform©

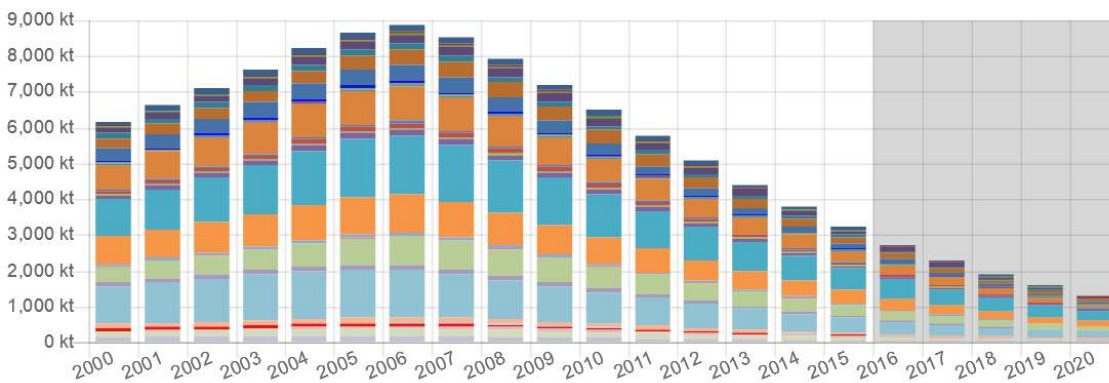
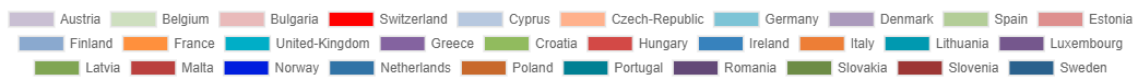


Figure 3. CRT displays in stock in EU. Estimate provided by the Urban Mine Platform©

Issues that have an impact on recycling CRT glass

Waste characterisation

In practice, currently, in most European countries panel glass is considered non-hazardous waste, whilst funnel glass is classified as hazardous waste due to its lead content. However, this is not fully harmonised in Europe and there are even disparities within Member States. In

³ Based on WEEE Forum members sampling campaigns (WEEELABEX batches).

some instances, funnel glass is classified as non-hazardous because it is considered that lead is not bio-available or bio-accessible, i.e. in inert form with no possibility of leakage. Additionally, the use of generic (ambiguous) descriptions such as “CRT glass” allows for a non-hazardous classification, whilst a hazardous waste classification should apply based on the precautionary principle.

Hopefully, Council Regulation (EU) 2017/997 regarding the hazardous property HP 14 ‘Ecotoxic’ will provide clarity and harmonise the classification of the different types of CRT glass. Furthermore, we also believe that in pro of the circular economy principles, there should be clear rules for the definition of end of waste criteria for CRT glass. These may open new alternatives for the recovery of glass in new (production) processes.

The lack of full harmonisation of the classification of panel glass complicates the process of shipping glass to the few specialist treatment facilities available in Europe. Harmonised criteria for classification, harmonised end of waste criteria for CRT glass as well as consensus among Member States would therefore be welcome.

Available technologies

Previous studies⁴ provided an overview of the current available technologies that are permitted to treat leaded glass from CRTs in Europe.

It should be noted that the treatment of screens has been in a transition period for an unexpectedly long period of time. Slowly decreasing amounts of CRT glass, and the slow increase of flat screens collected as waste are not favoring the development and use of specific new technologies for treating both types of screens. It is estimated that in the year 2020 in Europe still 2.400.000 tons of CRT's could be found in households and companies. Therefore, it is expected that the treatment of CRT's will still be required for another 10 – 15 years (EERA, 2018).

Additionally, preparing for re-use of CRT displays is not an option, due to the high environmental impact of using such appliances compared to new flat screen technologies and the digital switchover.

Finally, some Member States rejected backfilling or feedstock substitution in the tiling industry⁵ as options for the treatment of CRT glass, which resulted in landfilling being the only option.

We would welcome the harmonisation of treatment solutions for CRT glass supported by a short-term EU plan with incentives for developing recycling and recovery solutions to cover the existing demand.

Current available technologies in Europe are scarce, with limited capacity and sometimes rejected by national authorities, which gives rise to stockpiling and landfilling of CRT glass in more and more EU countries. Based on the circular economy principles, we believe that landfilling should be the last option for CRT glass.

⁴ “Leaded Glass from Cathode Ray Tubes (CRTs). A Critical Review of Recycling and Disposal Options”. Eliette Restrepo*, Rolf Widmer, Mathias Schlupe. UNU (2016); “Future disposal of CRT devices in Switzerland”. Rolf Widmer, Eliette Restrepo, Heinz Böni. Swico (2015).

⁵ Examples: Project Ecovitrum: <http://en.ecovitrum.es/>; Project clayglass: <http://www.lifeclayglass.es/?lang=en>

Impossibility for reaching recycling and recovery targets

On average, screens represent 10 to 20% of the total WEEE collected in an EU country (estimate based on WEEE Forum Key Figures©). This section provides some examples based on practical information from member states that conclude that it is not possible to achieve recycling and recovery targets for category two if there is no viable solution for recycling CRT glass.

For instance, if all types of CRT glass (panel and funnel) were landfilled in France, recycling and recovery rates would be:

Table 1.

	RECYCLING RATE	RECOVERY RATE
CRT SCREENS ONLY (REPRESENTING 86% BY WEIGHT OF THE SCREENS CATEGORY)	46,43%	50,43%
CATEGORY 2, SCREENS (INCLUDING CRT AND OTHER)	50,4%	55,2%
TARGET: 70 % PREPARED FOR RE-USE AND RECYCLED, 80 % RECOVERY		

Additionally, a second analysis on different scenarios for CRT screens was conducted in a different country with the following results:

Table 2

CRT SCREENS ONLY	RECYCLING RATE	RECOVERY RATE
PANEL GLASS IS RECYCLED, FUNNEL GLASS IS PARTIALLY RECYCLED (15%)	82,4%	84,3%
ONLY PANEL GLASS IS RECYCLED	67,0%	68,9%
NO CRT GLASS IS RECYCLED	36,7%	38,6%
TARGET: 70 % PREPARED FOR RE-USE AND RECYCLED, 80 % RECOVERY		

The Figures above were calculated with precise information collected from French and Portuguese data bases and using the WF-RepTool© methodology.

Finally, the following is a conservative simulation that concludes that it is extremely difficult, if not impossible, to achieve recovery targets for category two if there is no viable solution for recycling funnel glass. The simulation takes into account the variability of:

- the amount of CRT screens in category two and
- the recovery rates for other non-CRT screens (since different treatment solutions may be available in EU countries)

Table three assumes that all types of CRT glass from CRT screens (panel and funnel) are landfilled. The estimated recovery rate for CRT screens has been calculated as an average value of the figures provided in the two previous tables (i.e. 44,5%). The table shows that recovery rates are achieved only when the share of CRT screens in category two have reached levels of 30% and other non-CRT screens achieve recovery rates up to 95%. It should be noted that estimated recovery values for flat screens are currently around 80%.

Table four is a simulation in which only funnel glass, estimated as 26% of the total weight of CRT displays, is landfilled. In this case, the recovery rate of the CRT displays has been estimated as 69%. In this case, recovery rates for category two are achieved for shares of CRT screens equally or below 50%.

Table 3. Simulation, recovery rates for category two when all CRT glass is landfilled

All glass landfilled (60% of total weight)	- % of flat screens recovery +			
% of CRT screens in screens stream	65%	75%	85%	95%
90%	47%	48%	49%	50%
85%	48%	49%	51%	52%
80%	49%	51%	53%	55%
70%	51%	54%	57%	60%
60%	53%	57%	61%	65%
50%	55%	60%	65%	70%
40%	57%	63%	69%	75%
30%	59%	66%	73%	80%

Table 4. Simulation, recovery rates for category two when only funnel glass is landfilled

Funnel glass landfilled (26% of total weight)	- % of flat screens recovery +			
% of CRT screens in screens stream	65%	75%	85%	95%
90%	69%	70%	71%	72%
85%	68%	70%	71%	73%
80%	68%	70%	72%	74%
70%	68%	71%	74%	77%
60%	67%	71%	75%	79%
50%	67%	72%	77%	82%
40%	67%	73%	79%	85%
30%	66%	73%	80%	87%

The simulations and calculations above conclude that there are many scenarios that give rise to situations in the Member States where the recovery targets (80%) for category two cannot be reached when CRT glass is totally or partially landfilled.

Reaching the recycling and recovery targets for screens will be extremely challenging in the coming years for some EU territories. We believe competent authorities need to be aware of the factors leading to this situation and:

- align the existing regulations with the technologies in place, and
- launch short term actions promoting accessibility to and availability of CRT glass recycling technologies.

About the WEEE Forum a.i.s.b.l.

The WEEE Forum, set up in 2002, is a Brussels-based European not-for-profit association speaking for 36 not-for-profit electrical and electronic equipment waste (WEEE) producer compliance schemes – alternatively referred to as ‘producer responsibility organisations’ (PRO). The 36 PROs are based in Australia, Austria, Belgium, Canada, Czechia, Cyprus, Denmark, Estonia, Italy, Greece, France, Iceland, Ireland, Lithuania, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom. It is the biggest organisation of its kind in the world. In 2017, its member organisations reported collection and proper de-pollution and recycling of 2,100,000 tons of WEEE. Members in 2018: Amb3E, Appliances Recycling, ASEKOL, Australia New Zealand Recycling Platform, Ecodom, ESR, Ecotic, ECOTIC, Ecotrel, EES-Ringlus, EGIO, Electrocyclusis Cyprus, ElektroEko, Electronic Products Recycling Association Québec, Elektrowin, El-Kretsen, elretur, Environ, Fotokiklosi, Norsirk, Recipo, Recupel, Remedia, RENAS, Repic, Retela, RoRec, SENS e-Recycling, SWICO, UFH, Úrvinnslusjóður, Wecycle, WEEE Ireland, WEEE Malta, WEEE Recycle and Zeos. Contact: info@weee-forum.org. Website: www.weee-forum.org. See also [15 Years On](#).