

WORKING TOWARDS A SECOND LIFE FOR CRITICAL RAW MATERIALS IN ITALY – PRECIOUS METALS, BATTERIES AND FLAT PANEL DISPLAYS

The Critical Raw Material (CRM) Closed Loop Recovery Project aims to increase the recovery of target CRMs by 5% by 2020 and by 20% by 2030. To achieve this, the project has invested in trials exploring novel ways to boost the collection and recovery of CRMs from household waste electrical and electronic equipment (WEEE).

Held across the UK, Italy, Germany and the Czech Republic, the collection trial mechanisms included retailer take-back schemes; reuse containers at household waste recycling centres, business collections, university drop-off hubs, school collections and other collection events.

RECOVERY FROM COLLECTION

One such CRM recovery trial was managed by ECODOM. Founded in 2004 and operational since 2008, ECODOM is the largest Compliance Scheme in Italy with 30 members and approximately 57% of the Italian market share in large household appliances. In 2017 ECODOM collected and treated more than 105,000 tons of WEEE (more than 35.5% of all such items collected in Italy through the whole WEEE system).

Within this trial, ECODOM's primary objectives were to target and analyse the recovery of graphite, cobalt, gold, silver and platinum group metals from WEEE and batteries, and to develop a dedicated procedure to test the potential for preparation for re-use of Flat Panel Display (FPD) Monitors.



Link between collection and recovery

As demonstrated within ECODOM's [collection trial](#)¹, synergising WEEE collection and CRM recovery activities was a fundamental objective of their endeavours. During the collection trial, the focus was set on increasing the concentration of high-CRM containing WEEE that would be advantageous for the recovery trial. As some of the recovery trial treatment activities required information around the performance of the collection trials, these were performed in parallel.

Methodology

Precious Metal Recycling (PMR)

Collected WEEE was sorted, separated and pre-processed into CRM-rich and non-CRM-rich fractions.

Sorted WEEE was then sent to the STENA Technoworld facility (Angiari, Italy), which is equipped with PMR technology.

Separated fractions were passed through the different steps of STENA's existing precious metal recovery process.

Resulting output materials were sent to a specialized laboratory to identify the amount of copper, gold, silver, palladium, platinum and rhodium recovered.

CRM levels were assessed to determine if the method of collection and levels of sorting led to an overall increase in CRMs captured.

¹ <http://www.criticalrawmaterialrecovery.eu/home/casestudies/collect-more-collect-better>



Batteries

Batteries from the WEEE stream were sent to the SEVAL plant (outside of Lecco, Italy) to implement lab-scale processes to extract CRMs from rechargeable batteries.

Pre-treatment activities including stabilisation in a cryogenic atmosphere and material separation (shredding); followed by lab analysis for material characterisation.

Secondary treatment activities, including advanced separation and component dissolution (leaching process); recovery and purification: separation of high-value components/elements (selective extraction).

FPD Monitors

The FPD monitors collected were kept separately from other WEEE and sent to STENA Technoworld facility (Angiari, Italy).

Together with ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development), a comprehensive procedure was defined for the test and performances evaluation.

Firstly, the examined flat screen undergoes a visual inspection to identify damages, breakage or surface scratches.

Secondly, a functional test is performed. Through the support of open access MONITOR TEST software, 19 different parameters were evaluated and corresponding tests were performed (e.g. a monitor geometry test).



TRIAL RESULTS

Precious Metals Recovery

- A general recovery increase (compared to traditional low-CRM mix performance) of 102% of gold, 29% of silver and 42% of platinum group metals was observed.
- Provided that external conditions (additional pre-treatment steps, composition of the streams) were in place, STENA operators noted an improvement in the quality of output materials coming from the separated treatment.

Batteries

- **Cobalt:** 8% recovered from the **liquid solution**, which is the output of the hydrometallurgic treatment steps.
- Production of a **solid fraction**. This is the fraction that contains graphite, and represented the 12% of the total input material.

FPD Monitors

- A detailed procedure with 19 different parameters was defined to evaluate the preparation for re-use potential.
- Achieved a 100% recycling rate of the CRM contained in the FPD monitors declared as “re-usable”.

LESSONS LEARNT

- The quality of the collected WEEE (with a targeted high CRM content) was a crucial factor in the performance of both the PMR and battery treatment processes. The results suggest a need to further invest in the promotion of effective and targeted collection.
- When implementing the cobalt recovery process at industrial scale, it would be possible to drastically reduce the manual effort of the plant operators, thus reducing the cost and the time consumption, through the adoption of different equipment.



- From knowledge gained during the recovery trials, the most effective way to conserve CRMs is through re-use, allowing no losses as the units are given a second life. This suggests further exploration into the possibility of setting up organized, reliable and accurate methodologies to perform the preparation for re-use of FPD monitors.

BUSINESS BENEFITS

- STENA Technoworld decided to implement a work station to explore the preparation for re-use of FPD monitors leading to one new full-time job.
- This CRM Recovery Project trial has tested and demonstrated a number of repeatable, lab-scale (but scalable) processes for the recovery of CRMs from WEEE items.
- The trial has also successfully demonstrated the important link between WEEE collection and CRM recovery, which can serve to increase the latter.
- The learnings and outcomes of this trial have provided valuable input into the EU-wide policy and infrastructure recommendations that will be published shortly, and which could be applied in a commercial setting to increase the recovery of CRM-rich components from data-bearing devices.

