

Science for Environment Policy

Eco-design for flat screens should ensure quick dismantling for maximum resource recovery

Flat screen televisions and computer monitors should be designed so they can be quickly dismantled for recycling, a recent study says. The researchers calculated that in order to ensure the recycling process remains economically viable, it must be possible to disassemble small screens in less than 11 minutes. Good design could lower the costs of recycling and enable near-total recovery of precious metals from the waste screens.

Electronic displays are a significant stream of [waste](#) electrical and electronic equipment (WEEE). For instance, in the EU, 30 million of these products will reach the end of their life in 2015. They contain precious materials, such as gold, silver and palladium, and toxic substances, including mercury and arsenic; their end-of-life treatment is therefore important for economic, environmental and health reasons.

For this study, researchers investigate practical recommendations for the eco-design of electronic flat screen displays to make them easier to recycle and to improve [resource efficiency](#).

Manual dismantling is an important part of the complex recycling pre-processing phase as it allows over 90% of the precious metals in waste flat screens to be recovered. Manufacturers continuously research how to improve the design-for-disassembly of flat screens, thereby improving the cost-effectiveness of manual pre-processing.

However, the researchers warn that, within the next decade, screens are likely to become more complex in design and will need longer to take apart. This would make manual dismantling economically infeasible, and new shredding techniques more attractive, because they are quicker and cheaper. However, it is difficult to separate and recycle precious and scarce metals from shredded material.

The researchers analysed the dismantling of waste flat screens in an Italian recycling plant as part of the study. Large variations in the time for dismantling were observed, even for displays with similar sizes. This showed that the design of the displays largely influences the dismantling processes. While the time periods for dismantling several displays were quite short, new complex designs could cause the time periods to be raised to the point that manual dismantling is no longer economically viable.

For manual dismantling to remain viable, the researchers calculated that it must be possible to disassemble small displays (51 cm screen) in less than 650 seconds (10.8 minutes). Large displays (94 cm) should take no more than 1280 seconds (21.3 minutes) to dismantle.

They reached these timings by considering two key recycling costs: labour costs of dismantlers, assumed to be around €150 per day, and the value of precious and scarce metals in the displays' printed circuit boards and thin-film transistor panels. Precious metal recovery is the main economic driver behind WEEE recycling.

Compared with shredding, the manual extraction of circuit boards from small displays yields an extra 46.2g of copper, 0.44g of silver, 0.15g of gold and 0.03 g of palladium for each display. Circuit boards manually extracted from large displays provide an additional 80.7g of copper, 0.77g of silver, 0.25g of gold and 0.05g of palladium, compared with shredding.

Based on current market values, these metals could generate revenue of €3.5-4.3 for small screens and €6.1-7.6 for large screens. Thin-film transistors contain indium in quantities that are worth €0.13 from small screens, and €0.23 from large screens.

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Manufacturers could use these target disassembly times as design objectives, the researchers say, and they discuss a number of options. Dismantling is quicker if screws, instead of glue, are used to fix components, for example. However, many screws in a variety of sizes will slow the process. It may even be worth reconsidering the design of the whole product, they say, as circuit boards and thin-film transistor panels are currently deeply embedded in the product, making them difficult to access.

To encourage better design, the EU's [Ecolabel](#) could be awarded to flat screens with short dismantling times, the researchers suggest. This has now been included in the last draft of the Ecolabel criteria on electronic displays (and computers) that are currently subject to revision and scheduled to be adopted in 2015. Products which take too long to dismantle could be removed from the market under the [Ecodesign Directive](#).

The researchers conclude that manual dismantling is essential and resource efficient; however, they do not propose full manual dismantling of the whole device, but for integration of selective dismantling with mechanical treatments.

