



Market Insight: The need for LCD Recycling...

Background

Liquid crystals are currently used in a wide variety of applications ranging from small electronic displays such as digital watches to 100-inch TV Liquid Crystal Displays (LCDs). According to NDP Display Search global, the total TV LCD sales in 2010 were **250 million**, of which more than 110 million units were CCFL LCD's (See Fig. 1). Given that many LCDs have a short lifespan of 7-8 years, a large amount of LCDs are made redundant each year and require proper disposal.

LCDs now represent **10-20% of the waste display** screen intake at recycling facilities with volumes rising each year while the remaining **80-90% are cathode ray tubes (CRT) displays**. There will be dramatic reduction in CRT displays entering recycling facilities in the future, inline with a corresponding rapid and steep increase in LCD's at recycling facilities. This change is already happening and has been seen in certain markets such as Switzerland and UK already.

2008, marked the rapid decline of CRTs, sales volumes of CRT TVs dropped to new lows while CCFL backlite LCDs were on the raise. This was augmented by sales volumes of CRT monitors also dropping to just 0.1% of the total market share, compared with 68% in 2004. In 2008, the largest global manufacturing companies announced that they would stop the production of CRT-based TV sets and computer monitors. Since 2008, they have been selling off the remaining stock¹. The dominance of LCDs took hold since then and we are about to see the first real wave of LCDs coming back for recycling and the market will only grow.

The recycling of LCD panels poses a particular problem for electrical and electronic equipment (EEE) producers and hence their designated recyclers. The WEEE² Directive³, which all EU member states must transpose in national legislation and implement, stipulate that components containing mercury and liquid crystals must be removed from LCDs on disposal. WEEE recycling companies are currently struggling to comply with these directives.

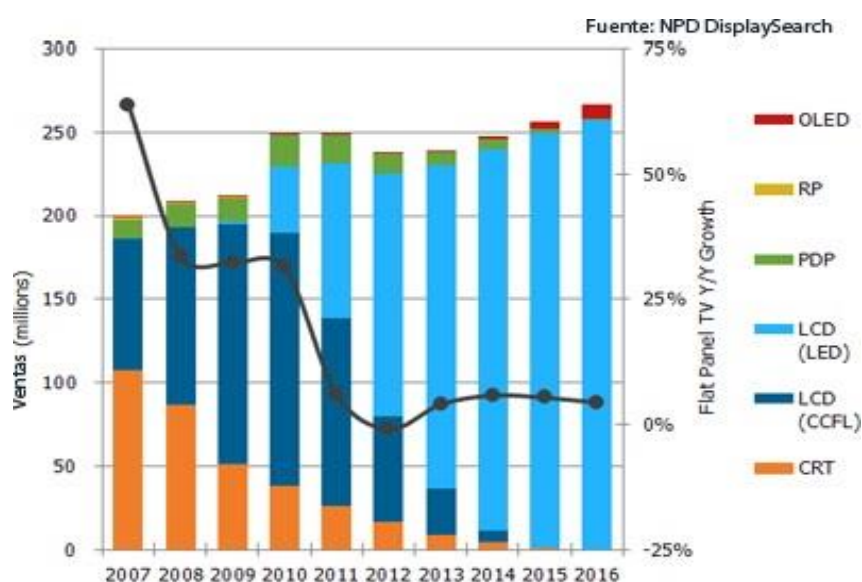


Figure 1. Global TV sales forecasts according to their technologies between 2007-2016 (NDP Displays Search, 2012)

¹ <http://eco2eco.com/articles/2013/05/24/kinescopes.html>

² <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012L0019>

³ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011L0065>





Key Facts on Flat Screens

Table 1

LCD fraction breakdown / ton – (Source: ReVolv Market Surveys 2017)	Share in weight %
Metal (lightbox casing, PCB mount, Plastic (Covers, clamping frame)	46%
Circuit boards	21%
Speakers	11%
Perspex	5%
ALU G1	3%
Diffuser foil	2%
G2 Cable	2%
Reflective Foil	1%
CCFL tubes	1%
Glass panel (LCD screen)	7%

The majority of recyclers use a manual disassembly (85% according to a WEEE Forum Survey 2017) process to remove the mercury lighting tubes and liquid crystal panel which is a slow and labor intensive process as LCD displays have a complex internal structure which consists of layers of circuit boards, mounting frames, enclosure cells, fluorescent tubes, liquid crystal glass panel, filter sheets and typically between 100 to 150 screws. Table 1 illustrates the breakdown of main components and their typical or average weight percentage within a LCD display. The value of such components as recyclable materials is estimated as an average at approx.. €3.60 per LCD display.

All this variation means that a typical 32-inch LCD TV takes **8-15 minutes** to be separated manually by one worker. This translates to **4-7 LCDs per hour** dismantled per worker. The

difficulty of LCD disassembly combined with high costs has led to a situation for a tendency to stockpile LCDs at recycling facilities across Europe.

LCD Recycling Market

Approx. Global LCD sales 2016	220 million units
Approx. European LCD sales 2014	33 million units
https://www.broadbandtvnews.com/2016/11/25/report-worldwide-tv-market-begins-stabilise/ https://www.channelnews.com.au/global-tv-market-to-reach-86-billion-by-2017/ https://www.rapidtvnews.com/2016120645324/lcd-tv-shipments-set-for-modest-annual-growth-in-2016-2017.html#axz54Gc4ndqN http://www.hiddenwires.co.uk/news/article/report-global-tv-shipments-to-drop-in-2017 https://www.broadbandtvnews.com/2015/04/09/tv-set-sales-rise-in-western-europe-in-2014/	

There are three main categories of LCDs, one group is CCFL back lite LCDs (which use a Cold Cathode Fluorescent Tube (CCFL) to light the screen which is made of a liquid crystal Panel) while the second category is called LEDs (which use a Light Emitting Diode -LED to light the screen which is still made of liquid crystal panels) and the less common third is EL-LCD (which uses electro-luminescence to light the liquid crystal panel). Both these types of LCDs fall under the WEEE Directive and require the liquid crystal panel be removed at end of life while for the LCDs the CCFL tubes must also be removed.

CCFL LCDs (also just known as LCDs)	LCD TV with CCFL backlighting
LEDs	LCD TV with LED backlighting

Given that LCDs have an average 7-year life time (Zhuang, 2012) and the amount of LCDs appearing on the WEEE recycling market is now rapidly increasing - they represent the recycling challenge for the next 15 - 20 plus years.





Securing the Future

There is a business continuity from the rapid decline of CRTs with new opportunities arising in an evolving market, e.g. LCD recycling and accessing Critical Raw Material (CRMs) such as indium.

Most manufacturers are following Apple's lead as being "a closed loop supply chain" meaning they want to recover more elements from the devices than before and feed them back into their own supply chain. There are elements in LCDs that are now considered **critical raw materials** and there will be a huge push to recover these in the coming years as the price and/or restricted access for these raw material increases.

Given these market objectives, the ReVolV project has demonstrated the latest machine in its series called ALR 3000© for fully automated high speed recycling of LCDs enabling capitalization of this particular market opportunity. This first machine is designed to process CCFL- LCDs, while the technology is designed to be adaptable to LEDs. See www.revolveproject.eu for more information.

More Information on ReVolV Project

Project Partners:



www.RevolvProject.eu

