

LAYMAN'S REPORT

PROJECT ECOVITRUM LIFE 08/ENV/E/000148



A second chance for discarded TVs and computer screens

Did you know that discarded TVs and computer screens can be converted into construction material?



www.ecovitrum.eu



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1- PROJECT SUMMARY.

Background, situation with obsolete televisions and monitors.

In 2010 alone, one million units (Cathode Ray Tube (CRT) televisions and monitors) were withdrawn in Spain, representing more than 30,000 tonnes of glass to be treated.

The management of waste created by these devices has been aggravated by two fundamental factors that have led to their withdrawal en masse: the availability of cheaper LED, PLASMA and LCD technology, and the digital switchover. This situation led to an exponential increase in the number of obsolete units requiring management during 2008, 2009 and 2010.



The large number of obsolete TVs/monitors has given rise to an environmental challenge for local authorities, which are responsible for the management of municipal waste. The

municipalities are also responsible for the management of recycling centres/municipal collection points, which have received the vast majority of the withdrawn equipment in bulk and in a short period of time.

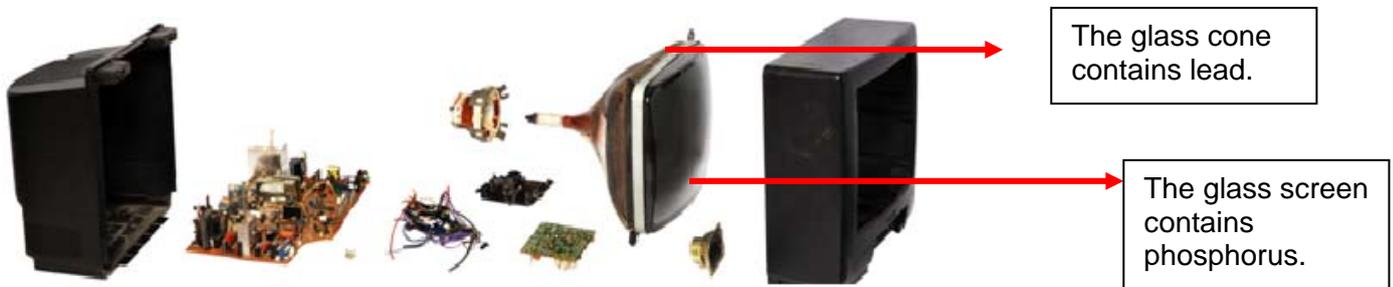
This type of waste requires specific transport and storage systems to avoid problems related to the dispersion of pollution and to enable its correct management in Waste Electrical and Electronic Equipment (WEEE) treatment plants.

Key issues for the storage of equipment in municipal collection points:

- Massive withdrawal of equipment in a short period of time.
- Problems of vandalism and theft of materials.
- Lack of quality standards for television and monitor storage systems.
- Lack of awareness of the importance of maintaining CRTs in optimum conditions for subsequent recycling



Cathode Ray Tube (CRT) technology was developed in the forties for viewing images on conventional televisions and monitors. This type of tube, which represents 50% of the equipment's total weight, is mainly composed of glass, although it is coated with other materials, such as phosphorus and lead. At the end of their useful lives, CRTs require proper treatment as they may be toxic and harmful both to health and to the environment.



The processes for managing obsolete equipment are as follows. Once withdrawn from use, the televisions and monitors are transferred to a waste electrical and electronic equipment (WEEE) treatment plant, where they are subject to a number of processes for the removal and selection of certain materials, such as metals and plastics for their subsequent shipment to recycling companies. These processes

also include the removal of the Cathode Ray Tubes, for which there is no real market demand, meaning that they must be stored in safety landfills until the implementation of the Ecovitrum project.

2- GOALS.

The project's main goal is to demonstrate the possibility of applying an obsolete television and monitor (CTR) take-back system model that enables the reuse of the units' glass as a raw material for the manufacture of new products. Ecovitrum is to be established with the aim of implementing a new management model, covering all aspects from public awareness to the search for technical and market opportunities for the glass obtained from the treatment processes carried out in the pilot plant.

The implementation of this new management model will have direct effects on the municipal collection points, the take-back systems and the WEEE selection and treatment plants, with the aim of obtaining improved performance in the recycling of Cathode Ray Tube glass.

Partners involved in the project.

The Ecovitrum project has met the goals and objectives initially established, thanks to the joint work of the seven partners that make up the consortium. This working group, led by the Valencia Provincial County, is formed by all the agencies involved in the daily management of waste electrical and electronic equipment, in addition to companies and institutions capable of providing a real use for such waste.

As the leader of the project, Valencia Provincial Council is responsible for the implementation, coordination, justification and dissemination of the project. 7 partners have participated in the project's development, taking on different technical and economic responsibilities.

Fundación Eco-Raee, which is responsible for coordinating manufacturers, storage centres and waste managers. Recytech Iberia SL, the first plant in Valencia approved for the treatment of waste electrical and electronic equipment.

In addition to the work necessary for the treatment and adaptation of the withdrawn CRT glass, this company has been responsible for the design of the prototype for obtaining cathode ray tube glass ready for use as a raw material. The Construction Technology Institute (*AIDICO*) is responsible for studying potential construction materials that can be developed using CRT glass and for carrying out quality control testing on the products produced under European regulations.

The Cullera City Council has a municipal collection point in which various measures for improving this type of facilities and the subsequent recycling of televisions and computer screens to be sent to Recytech's treatment plant have been studied.

Esmalglass, which is specialised in the manufacture and marketing of components for the ceramics industry (frits, glazes and ceramic colours), has been able to reuse television and computer screen glass on an industrial scale as a raw material for the production of new, more sustainable ceramics products.

The Hungarian company Electro-Coord has been commissioned with the study of the various initiatives that are being developed in Europe for the management of obsolete TVs and monitors and their application in Spain and Hungary. *Fundación Comunidad Valenciana Región Europea* has developed a communication plan for the project on a European level, designed to disseminate the project's progress and results from its headquarters in Brussels.

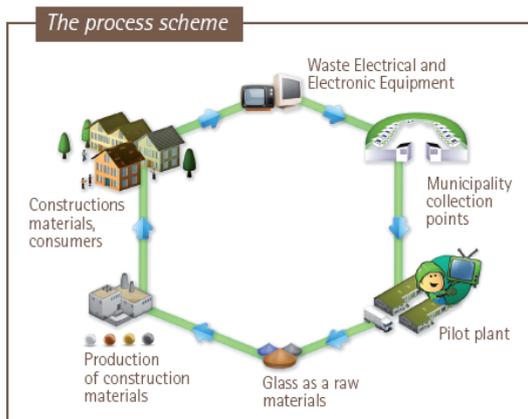
All the partners have participated in the project's development, both on its technical and on its financial aspects. Furthermore, mention may be made of the fact that the work systems and the improvements implemented for the storage, transportation, treatment and use of obsolete TV and monitor glass have enabled the implementation of an optimum take-back system for all parties involved.

The management model developed by the Ecovitrum project will allow us to continue recycling obsolete TVs and monitors until the finalisation of their withdrawal (at least a further 10 years), thus avoiding their disposal in landfill.

Project partner logos.



3- TECHNIQUES AND METHODOLOGY



In order to support the Councils in the challenge they face managing obsolete TVs and monitors, in 2008 Valencia City Council designed the Ecovitrum project.

With a total budget of almost 2.4 million euros, Ecovitrum was selected for funding under the EU LIFE+ programme, obtaining 48% of its implementation costs. This project addresses an environmental problem that is common throughout all European Union countries: the proper management of waste electrical and

electronic equipment as embodied in WEEE Directive 2012/19/EU, on electrical and electronic equipment and the management of its waste.

Working methods.

- Analysis of the different measures taken in the EU for the management of waste electrical and electronic equipment, search for new applications for CRT glass.
- Improvements in the reception of TVs and Monitors reception in municipal collection points and the coordination with the Take-back Systems.
- Adaptation of obsolete television and monitor treatment systems, selection and sampling of CRT glass in WEEE treatment plant.
- Technical and market analysis for the application of CRT glass as a raw material in the production of various construction materials.
- Implementation of an environmental awareness campaign to promote the recycling of electrical and electronic equipment.
- Design and implementation of a pilot plant for the production of CRT glass on an industrial scale suitable for use in the manufacture of building materials, with a maximum treatment capacity of 15,000 units per month.
- Implementation of industry-wide test for the application of pre-treated obsolete television and monitor glass in the current construction materials manufacturing system, mainly in the ceramic components industry.
- Evaluation of the results obtained from monitoring the behaviour of the new materials generated and their practical application by means of a system of indicators and a measurement programme to assess the benefits of the project's implementation.

Functional diagram of the management model.

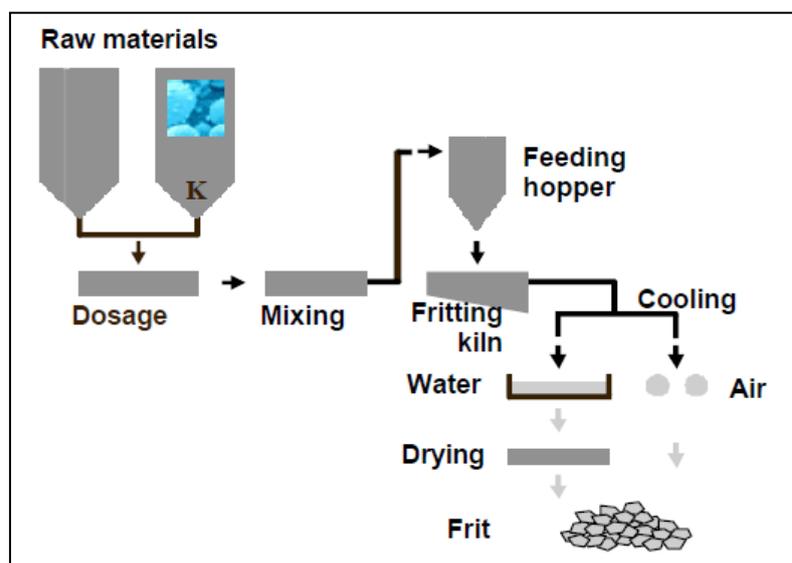
The televisions and monitors deposited by citizens both in collection points and in shops are transferred to the Recytech treatment plant. Once there, they are subject to a series of treatments to decontaminate the CRT glass and to adapt it to its subsequent use as a raw material, taking advantage of its special composition of barium and strontium oxides.



The treated, decontaminated glass is then transported to the facilities of Esmalglass, the ceramic components manufacturing partner.

After passing stringent quality and environmental controls, the glass is incorporated as a substitute for certain natural raw materials into the frits, glazes and engobes production systems. The resulting materials are essential components in the manufacture of all types of flooring and wall tiles, in addition to being responsible for providing texture, gloss and resistance to the final product.

The ceramic materials obtained from recycled glass comply with the UNE-EN 14411:2007 standard for ceramic tiles, thus ensuring the use of CRT glass as a raw material in industry.



(Diagram of use of glass for the production of ceramic components)

Other materials developed.

At a laboratory level, the Construction Technology Institute (*AIDICO*) has managed to produce, through the use of CRT glass, other construction materials, such as; resin-based materials, cement-based materials and insulating materials.

The different materials produced from recycled glass comply with the current regulations governing construction materials and have also passed various internal and external quality and environmental controls for their use in the market. The use of recycled glass enables the production of more environmentally-friendly materials whilst simultaneously reducing the consumption of natural raw materials.

4- IMPACT.

Project Results, Innovation and Improvements.

The innovation represented by the Ecovitrum project is based on implementing a new management model for obsolete televisions and monitors from a comprehensive perspective.

The model covers all the stages that influence the collection, transport and selection of these residues, in addition to establishing strategies involving all the interested parties for the residue's subsequent recycling as raw materials.

Additional innovations with effects on the management of WEEE include the work carried out to raise public awareness, as citizens are both interested parties in terms of the success of the project and a key factor in converting such waste into a resource.

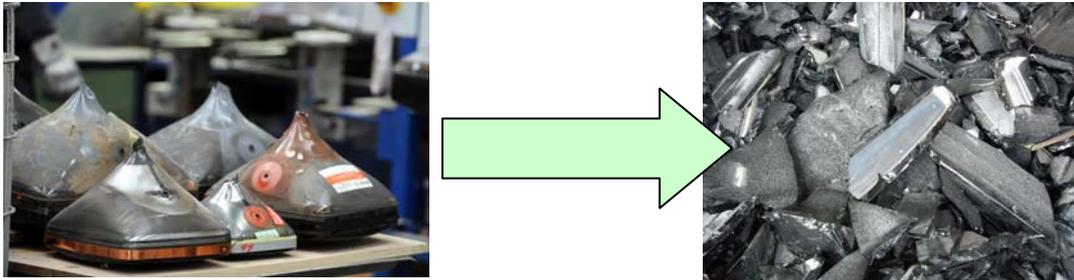
Improvement in waste storage and transport.

The technical innovations implemented in relation to the storage and transportation systems have consisted in improving the municipal collection points' security systems and the design and implementation of a pilot container. This innovative infrastructure, which was designed exclusively for the project, has minimized the theft and breakage of TVs and monitors, thus facilitating their recycling.



Improvements in glass management systems.

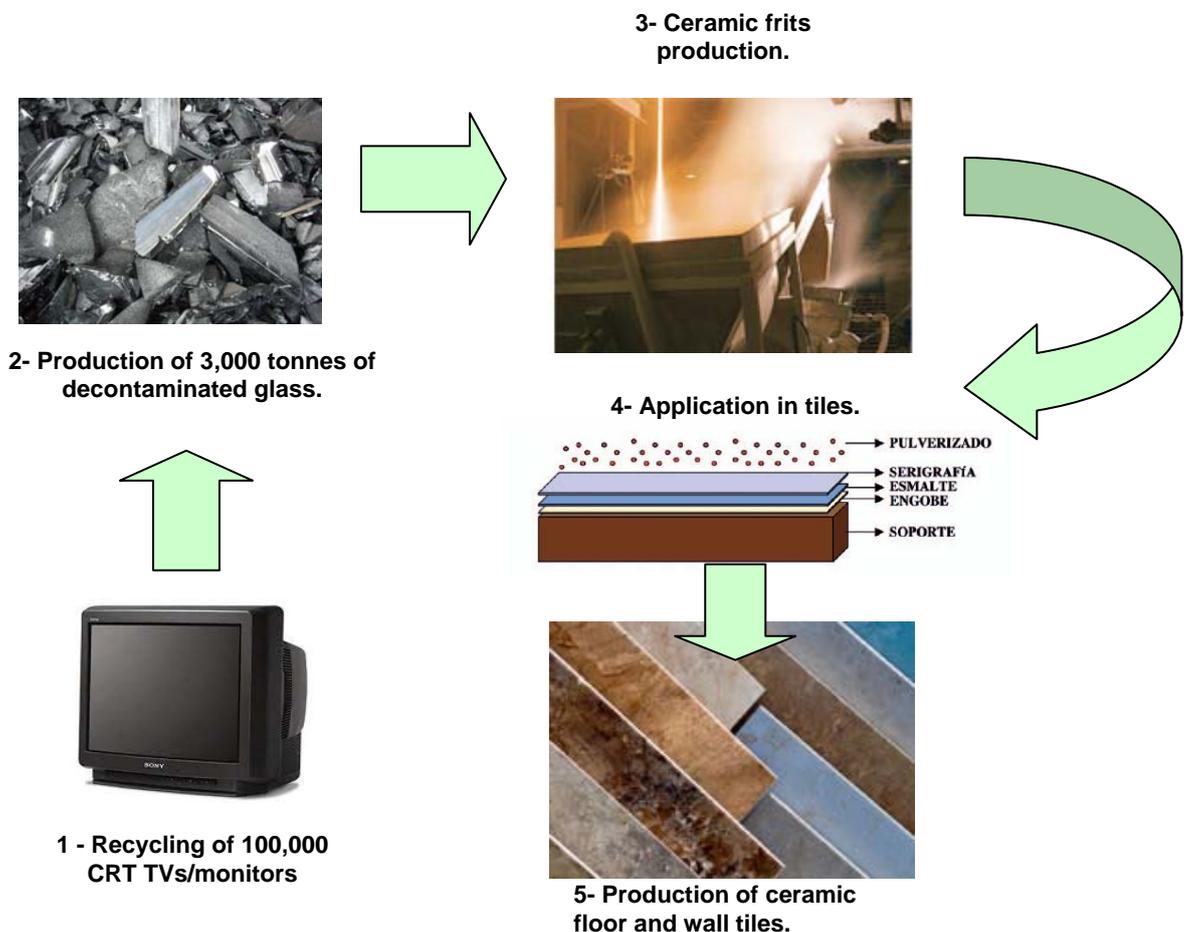
Development and implementation of a protocol for the obsolete Cathode Ray Tube television and monitor treatment plant which enables characterised, pollutant-free glass to be obtained for industrial use.



Improvements in the application of glass as a raw material.

The treatment and decontamination treatment processes have enabled the production of glass suitable for use as a raw material in industrial processes. This recycling model has facilitated the use of recycled glass without requiring changes in the ceramic component production processes. CRT glass used as a substitute for natural raw materials adds value to the final product as a more sustainable material.

The Ecovitrum project has demonstrated its technical development through the reuse of 3,000 tonnes of CRT glass for the production of ceramic components, representing the total recycling of 100,000 obsolete units.



Implementation of the prototype, improvements in the treatment of TVs and monitors received in poor condition.

In order to properly manage televisions and monitors received with deteriorated CRT glass, a 6000 tonne/year-capacity pilot plant capable of eliminating phosphorus particles from the glass has been designed and commissioned.

This pilot plant facilitates the decontamination of mixed glass and the supply of a material with the necessary technical properties for its use as a raw material in the production processes of various types of construction materials. The prototype is capable of treating glass from all types of CRT TVs, including units that arrive at the plant with fragmented CRTs and which, due to the lack of suitably technology, were previously deposited in safety landfills.

5- ENVIRONMENTAL BENEFITS.



The main environmental benefit of the Ecovitrum project consists of the reuse of obsolete television and monitor glass, which was previously considered waste due to a lack of real market demand. It can now be reused as a high-quality raw material for the production of new materials, mainly in the ceramics industry.

Other environmental benefits obtained include:

- Minimization of the uncontrolled dumping of televisions and monitors thanks to environmental awareness campaigns carried out in 12 municipalities, 19 educational centres and 6,500 schools.
- Support for compliance with the recycling rates for waste electrical and electronic equipment established by the current legislation, thus avoiding the dumping of glass.
- Minimization of the use of landfills for the disposal of cathode ray tube glass.
- Development of pioneering green, sustainable technology in Europe.
- 100% use of the waste's components.
- Minimization of the use of natural raw materials thanks to the processing of more than 6,000 tonnes of CRT glass.
- Reduction in the consumption of raw materials: silica, barium and strontium oxides.
- Reduction in energy consumption for the manufacture of new products.
- Production of construction materials with lower environmental impact through the use of recycled materials.
- Raising of public awareness on environmental protection and improvement.
- The involvement of local industry in the use of this type of waste as a source of raw materials.

Other achievements.

The implementation of a new take-back system for the treatment of waste electrical and electronic equipment has obtained the following results:

- Improvement in the functioning of municipal collection points.
- Production and commercialization on an industrial scale of ceramic wall and floor tiles using CRT glass as a raw material.
- Implementation of a pilot plant, a pioneer in Europe, for the treatment obsolete televisions and computer screens, with capacity of 15,000 units per month and 6,000 tonnes per year.
- It will avoid the use of 3,000 tonnes of natural raw materials, to be replaced by TV glass.
- Development of a code of good practice to improve the management of TVs and monitors in municipal collection points, thus increasing their recycling rate.
- Production of glass capable of replacing 25-15% of the natural raw materials without changing current ceramic component production systems.
- Preparation of construction materials using obsolete television and monitor glass, such as: ceramic materials, insulation materials, resin-based materials and cement-based materials.
- Development of cutting-edge technology in Spain for recycling obsolete TVs and monitors.
- Promoting the use of green building materials made from recycled products and causing less environmental impact.
- Implementation of an environmental awareness campaign in 19 education centres and 12 municipalities within the province.
- Dissemination of project's results at three international environmental fairs, four domestic fairs and a total of 5 professional seminars



CRT glass ready for use as raw materials, Esmalglass

6 - PORTABILITY OF TECHNICAL SOLUTION ADOPTED BY THE ECOVITRUM PROJECT.

The massive withdrawal of televisions and monitors, and the lack of solutions for managing this type of waste, is a common problem in most European Union countries.

Moreover, the problem has not given rise to real glass recycling solutions in other European countries, with the only options adopted so far being the use of glass as filler in cement or its direct deposit in landfills.

The transfer of the project's results is therefore very important in terms of waste management on a European level. Ecovitrum has managed to implement and demonstrate the existence of a comprehensive system for the treatment of televisions and monitors and their subsequent processing as raw materials for the ceramics component industry.

The application of CRT glass on an industrial scale has proven to be wholly feasible, and to do so ceramics component manufacturers must make use of the experiences and results obtained in the Ecovitrum project.

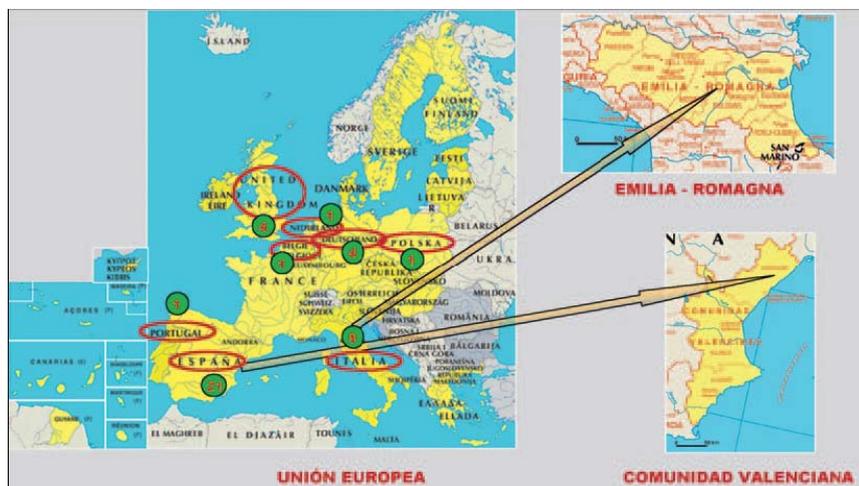
This technology can be transferred to other European Union countries, as the ceramics components manufacturing processes are highly standardized throughout the industry and are very similar in most European companies. The management of CRT glass as a raw material does not require major changes in ceramics components production systems, thus facilitating the portability of the Ecovitrum solution to other European countries.

As well as in Spain, ceramics materials are produced in countries such as Italy, Portugal, Belgium, Germany, Holland and Great Britain, and as such there is a real demand for raw materials in several European countries, making the application of this model wholly feasible.

The management model developed by the Ecovitrum project has established itself as an essential tool for compliance with WEEE Directive 2012/19/EU, thus meeting the priority established for recycling in the management of waste electrical and electronic equipment.

The Ecovitrum model may be transferred, as recycled CRT glass adds value to the final product, due to the substitution of natural raw materials by waste, and the more sustainable nature of the products obtained.

The Ecovitrum project has achieved its main objective, demonstrating the technical viability of an optimal take-back system for the management of CRT glass in the ceramic industry, transferable to other EU countries.



Map of European ceramics producers.