

*Una manera de hacer Europa*



# BUENAS PRÁCTICAS

## Operaciones Cofinanciadas

“Sustainable Economic Recovery of  
Electronic Waste”.

Agency for Management of University and  
Research Grants (AGAUR)

# Programa Operativo de Cataluña

Fondo Europeo de Desarrollo Regional

**Año 2017**



**Submitted as Good Practice: the project “Sustainable Economic Recovery of Electronic Waste”.**

This project comes under the line of action that focuses on tools to support the valorisation and transfer of innovative knowledge. More specifically, it comes under the knowledge industrial call for proposals to cofinance technology transfer projects aimed at enhancing cooperation between universities and companies, principally for the benefit of SMEs. The body responsible for managing this call for proposals is the Agency for Management of University and Research Grants (AGAUR) of the Government of Catalonia’s Ministry of Business and Knowledge.

The objective of this project, which is being developed by the Polytechnic University of Catalonia (UPC), valorise the basic research conducted into the recovery of valuable metals from disused electronic material by using biotechnological techniques. In other word, for example, when a mobile terminal becomes obsolete, it is possible to reuse the battery and, if appropriate, break the terminal down without any negative impact on the environment. In short, under this project, biotechnology is applied to waste management.

The project, which has a total cost of 24,200 euros and an eligible cost of 20,000 euros, has received European Regional Development Fund (ERDF) support worth 10,000 euros. Five researchers are engaged on the project.

**This operation is presented as Good Practice because it meets the following criteria:**

**1. High level of dissemination among beneficiaries, potential beneficiaries and the general public**

The project was disseminated at the following events:

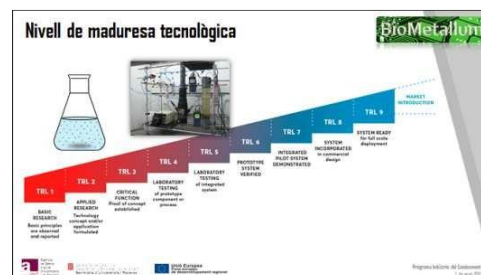
- **Mobile World Congress 2018**, at two sessions, on February 28 and March 1, in Barcelona. Public attendance to the congress was 107,000 people. The organisers of the world’s most important congress devoted to telephone technology invited the beneficiaries of the support to present a project based primarily on the circular economy to an audience specialised in mobile technology and the sustainable economy. This invitation enabled potential customers in the mobile industry to learn about a technology that can be applied in their process lines to extract value from all the disused equipment generated in the sector. They also had the occasion to discover at first-hand how technology enables the production of devices that are more environmentally friendly and depend less on limited natural resources, generating added value for the final product that final consumers greatly appreciate. The fact that this was an international congress also made it possible to establish links and cooperation agreements with private companies based in different countries around Europe and the world, as well as with leading research centres. The presentation focused on the potential value of the project to the mobile phone industry.



- Presentation of the project at the **20th Congress of Physicians and Biologists** in the Catalan Language, held in Manresa with 400 attendees. This congress, specialised in biological systems for different applications, received the initiative presented as part of the Llabor (Seed) grant as an innovative proposal for a biotechnological process applied, in this case, to the field of waste. At the congress, experts in biological processes and partners in the development of the product assessed the initiative and gave advice with a view to the final success of the project.



- Presentation of the project at the latest call for proposals of the **Government of Catalonia's Knowledge Industry Programme** (IdC 2018, 2 March 2018), launched by the Agency for Management of University and Research Grants (AGAUR). In this case, the organisers the Knowledge Industry Programme requested a presentation of the project development as a case that illustrated the success of the call. At the presentation, information was provided about the development of the proposal, the budget, the players that intervened and how participation in this programme was key to the technology development and market study that culminated in the registration of a patent, as expected under the terms of the project.



- Presentation of the project at the **22nd International Biohydrometallurgy Symposium** in Germany, with 300 attendees. At this important world event in the field of applied research, the participants in the project were invited to describe its development from the standpoint of innovation in the field of metal recovery using biotechnological methods. The Symposium was attended by leading companies in the sector, all potential clients of the technology proposed. The presentation focused on the role played by microorganisms in the project and the working conditions that enable the metabolic activities that are key to the success of the process.

Press, television and radio have all helped to disseminate the project through interviews and news items related to the prize for best proposal for business development awarded by the CaixaBank Foundation ([CaixaBank Prize news website](#)). Promotion was also provided by participation at leading events, including presentation of the project at the Mobile World Congress. The high media impact – this news was reported in more than forty national and international media – indicates the great social interest generated by the project, which also received second prize for Industrial Development Initiatives at a competition organised in Manresa to promote entrepreneurship.



At the same time, interviews were conducted with potential final beneficiaries from the project. The response was highly positive. Cooperation was obtained from them, and information about the project was published on the beneficiaries' website ([Project information website](#))

## 2. Inclusion of innovative elements

The proposal is notable particularly for its highly innovative nature, which generated a patent application (P201830406). The implementation of the project enabled the development of an alternative biotechnological process to conventional systems, with lower consumption of chemicals and energy and, consequently, reduced environmental impact. Moreover, it offers a business opportunity to electronic waste managers, as the proposal can be adapted to the characteristics of each different customer. This differentiates the project from processes conducted at present, which force these managers to sell their waste to other European countries at a price less than the value of the metal that devices contain. For this reason, the proposal encourages business development within the territory, generating jobs and local business activity.



## 3. Linkage between results obtained from the supported actions and the objectives established

The main objective of the project was to valorise the basic research conducted into the recovery of valuable metals from disused electronic material by using biotechnological techniques. To this end, it was first demonstrated at laboratory scale that, in certain conditions of pH, temperature and salt concentration, the selected microorganisms can extract metals with substantial economic value for reuse. A pre-prototype was designed and built at pilot plant scale in order to test the economic and technical feasibility of the technology at a scale closer to industrial level. At this higher working scale, it is possible to evaluate the behaviour of the technology as regards flows of materials that can be extrapolated to industrial scale and which enable a precise assessment of the technical and economic feasibility of the technology to be made. In this way, it was necessary to determine the optimum working conditions in terms of performance,



evaluating contact time, irrigation rates, inoculum and waste concentration ratios, and percolation rates. The support obtained from the Knowledge Industry Programme, cofinanced by the European Regional Development Fund (ERDF), made it possible to enhance the degree of technological maturity of the project as planned and to positively validate the hypotheses established.



#### **4. Contribution to resolving a regional problem or weakness**

As mentioned, the project enables electronic waste managers to implement a process line to recover metal contained in waste profitably and at their own facilities. All this can be carried out without the need to send the waste to large treatment plants outside the country. In order to be profitable, these large plants require large amounts of waste, and they generate high environmental impact. In Catalonia alone, the Metal Recovery Guide has more than 250 member companies. This potential enhances the local economy and generates jobs. At present, waste managers in our country are only able to act as intermediaries between waste collection centres and the large pyrometallurgical and hydrometallurgical enterprises.

The proposal also helps to meet the high demand for metal required for to produce electrical and electronic appliances in a highly technological society with a high turnover rate in such devices. All this, while also reducing dependence on natural sources of minerals from which to extract metals, finite resources that are located at highly specific points on the planet.

#### **5. High degree of coverage of the target population**

The results from this project benefit the population as a whole by articulating a more sustainable and environmentally-friendly technology proposal that resolves the problem caused by the negative consequences of the generation of electronic waste. Electronic waste is the type of waste that is growing at the fastest rate globally (by 3-5% per year), while the recycled fraction is very low. This project is based on the possibility of turning the problem into a business opportunity that also generates benefits for society as a whole.

In the current economic climate, and with the growing generation of electrical and electronic waste, the fact that these materials have economic potential makes this project an attractive business opportunity that can resolve a number of problems. The latest official reports quantify the amount of electronic waste in the world at 40 million tonnes, generated by soaring consumption of electronic devices. The main problem of this type of waste is that it contains toxic chemicals such as arsenic, lead, mercury and polybrominated flame retardants. However, disused devices also contain a high percentage of metals (40%) that have properties of great interest for new uses, such as copper, chrome, zinc, nickel, aluminium and precious metals (gold, silver and platinum).

Taking into account that the percentage of these metals in this waste is generally higher (10-20%) than in the natural sources from which they are extracted (0.5-3%) and that these sources are located in very specific places around the planet, the proposal, if successful, would generate a two-fold benefit: it would provide an alternative, sustainable source of metals while enabling management of waste that is highly hazardous to human health and the ecosystem.

The metals that can be recovered using the proposed technology include copper, for which demand has doubled in the last 25 years. This rising demand is explained by its electrical properties (copper is one of the best electrical conductors) and the resistance to corrosion of its alloys. It should be noted that this type of waste can contain up to 0.4% of precious metals such as gold, silver and platinum.

As reflected in a report published by the Telefónica Information Society Foundation, the project is highly attractive for our country, a European leader in the use of latest-generation mobile phones that also has a high turnover rate (81%), ahead of the UK (75%), Italy (69%), and Germany and France (both 67%).

The social interest of the initiative is made clear by the high media impact that the project has generated based only on the preliminary results. The forty or so media that reported the news highlighted the importance of recovering raw materials that have high value and are scarce at world level, the fact that the alternative process is more environmentally sustainable and reduces hazardous and toxic waste, and the possibility of valorising waste of low commercial value. Besides the support from several companies related to the sector, the Waste Recovery Guild of Catalonia, which represents more than 250 wholesale and retail company members, has also expressed great expectation should the proposal come to fruition. Two companies interested in marketing the technology are Electrorecycling and ACS Recycling, both engaged in specialised integral management.

## **6. Compliance with horizontal principles (sustainable development, equality between men and women and the principle of non-discrimination) and environmental legislation**

Through its director of business development, the Asproseat Foundation contacted the applicant to express an interest in adopting the technology to be developed in its lines of operation. The Asproseat Group provides services to people with disabilities, particularly intellectual impairment, promoting their personal and social integration, and working for companies engaged in the field of waste collection. Although the Asproseat Foundation pursues a social mission, its special work centres focus on productivity. At around the same time, the Ampans Foundation also expressed an interest in taking part some of the stages necessary to implement the process developed. The Ampans Foundation employs more than 800 workers and promotes education, quality of life and full inclusion for people with intellectual disability, mental illness or in situations of vulnerability. The Ampans Foundation gives such people guidance and support, providing education services, training, employment, day care, therapeutic occupation, residential care, leisure, sport and tutorship, and encouraging self-reliance and equal opportunities.

The technology proposed is a high-potential alternative to conventional pyrometallurgical and hydrometallurgical processes, which are characterised by high use of energy and reagents and great environmental impact. This is the main reason why the vast majority of electronic waste management companies in our country are forced to send waste collected here to other countries where, by centralising large volumes of waste, the conventional process can be made profitable. However, the prices paid for the waste collected is much lower than the value of the metal it contains. Comparison of the technology to be developed under this proposal and conventional processes shows that energy requirements are much lower in the latter case, as the work is

conducted practically at room temperature (that necessary to maintain the activity of the microorganisms) rather than the 1200-1250°C necessary in pyrometallurgy. Moreover, the use of aggressive reagents, such as hydrogen cyanide or sulphuric acid in the case of hydrometallurgy, is drastically reduced.



Besides the head researcher and applicant, the team that developed the proposal was formed by 6 women and 6 men, that is to say, a 50/50 gender balance.

## **7. Synergies with other policies or instruments of public intervention**

Based on this project, work focuses on the development of a proposal to be submitted to a RIS3CAT community. RIS3CAT, the Research and Innovation Strategy for the Smart Specialisation of Catalonia, is Catalonia's response to the European Union requirement for member states and regions to draw up research and innovation strategies for smart specialisation (RIS3) adapted to their potential for innovation. Specifically, this proposal will be submitted to Bioindustries for the Bioeconomy, a RIS3CAT community coordinated by Barcelona Autonomous University, under the title "Application of Biotechnologies in the Recovery of Industrial Waste", in cooperation with Manresa Technology Centre (a member of Eurecat, the Technology Centre of Catalonia). This call for proposals is currently at the preparation stage.