



# Recover, ReCreeW

ISWA National Committee member, **Ian Williams**, outlines the purpose and activities of the ReCreeW project – the European network for innovative recovery strategies of rare earth and other critical metals from electric and electronic wastes

The European Union funds a range of activities to support trans-national cooperation. European Cooperation in Science and Technology (COST) is the longest-running European framework supporting trans-national cooperation among researchers, engineers and scholars across Europe. The ReCreeW Project represents the first COST Action in the field of critical metal (CM) recovery from waste electrical and electronic equipment (WEEE).

The ReCreeW Project team was put together by Professor Kerstin Kuchta from Hamburg University of Technology in Germany. It includes representatives from Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Serbia, Spain, Switzerland, Turkey and the UK. The UK's representatives are myself and Peter Shaw from the University of Southampton; and Andrew Hursthouse from the University of the West of Scotland. The Project's interdisciplinary approach, which links natural sciences and engineering, political and legal aspects, is key to data and knowledge exchange that is realised via an internet platform, meetings, workshops and short-term scientific missions.

## Background

CRITICAL METALS, which include rare earth metals (REMs), are integral to electrical and electronic equipment (EEE) in steadily growing technologies like green (GT), information and communication technologies (ICT). Because of the high

complexity of the ores and their low REM concentration, the mining, extraction and refinement of REM in particular entails severe environmental impacts.

REMs are abundant in the earth's crust, but rarely available in commercially viable concentrations. Hence, extracting REM from the ores is a complex and energy-intensive process, often involving strong acids and/or high temperatures. Additionally, radioactive materials are often found alongside REM deposits. Due to the inseparability of the materials during mining, the refining of the REM can result in the production of large amounts of hazardous wastes.

Europe is one of the world's largest consumers of REMs without any own primary production. The deposits are located primarily in China, which could limit the export at any time, as it did in 2010. The increasing worldwide demand may result in scarcity, causing significantly rising prices.

It is therefore necessary to evaluate all possible alternative sources of CM when considering a future secure supply. The obvious alternative material stream is WEEE – high neodymium and yttrium concentrations are found in computers, generators and displays. However, WEEE is a non-homogeneous and complex waste stream and recycling needs a holistic management and treatment strategy.

Currently, the management of WEEE can be divided into collection, disassembly, mechanical pre-treatment and advanced treatment/refining. Each step involves major challenges, such as losses of WEEE in conventional waste

treatment and illegal waste transports. State-of-the-art recycling processes focus mainly on base and precious metals; the losses of REM are therefore almost 100 percent. The treatment needs to be adjusted to achieve a CM-rich output stream as a precondition for an efficient recovery. An optimised refining process is the final step to recover the CM and supply European industry.

Research activities, carried out in parallel in different European countries, are certainly less effective than coordinated actions. Each country may focus on specific aspects of the recycling chain, so the recovery of CM from WEEE cannot be conducted on a national level. However, such a holistic approach neither exists in industrial scale nor have there been any research activities covering all involved steps and disciplines. These challenges require experts from all steps of recycling and recovery to form interdisciplinary, transnational alliances, including engineers, chemists, biologists and toxicologists – hence the formation of the ReCrew Project team.

## Actions

THE PROJECT'S purpose is to promote a sustainable supply of CM from WEEE for future technologies. A key objective was the creation of a network made up of the scientific community, governmental bodies and industrial representatives of European states and scientific disciplines to develop ideas for effective WEEE recovery processes by promoting cooperation among researchers and professionals with different cultural and educational backgrounds. At this early stage of research a science-dominated program like COST is the optimal solution to determine the actual research needs. The project involves the organisation of specific programs including:

- the harmonisation/standardisation of research methods
- identification and characterisation of CM sources
- a policy framework for WEEE management
- process evaluation and innovation covering
- collection and transportation of WEEE
- mislead waste streams
- a concentration of CM by WEEE management
- (pre-)treatment (mechanical/chemical)
- refining (hydrometallurgy, bio-hydrometallurgy, extraction/sorption)
- emerging technologies (biosorption/di-electrophoresis)
- environmental impacts
- transfer to developing countries for sustainable WEEE management.

National experts from all relevant recovery phases are part of the consortium. The Project is structured as an open framework to allow additional experts to join the Working Groups or to expand work in the context of policy, dissemination or modelling. Activities include:

- the establishment of Working Groups
- an Internet-based project exchange platform for knowledge transfer
- scientific missions and summer schools that support involvement of early-stage researchers to promote their cooperation throughout Europe
- workshops involving stakeholders from EEE production

and distribution, as well as WEEE management and members of human health and environmental institutes, universities and companies; stakeholders are invited to join the Working Groups

- six-monthly general meetings to share and discuss knowledge tackling scientific and technical aspects
- capacity building for researchers and stake holders
- dissemination activities, such as websites, flyers, social media, publications etc...

## Benefits

RECREEW'S INTENTION is to promote a sustainable supply of CM from WEEE for future technologies. By improving recovery and retention of CM in Europe, the dependency on unstable countries with primary resources and the loss of material can be reduced. The Project entails social, economic and financial benefits for Europe by promoting new recycling branches and, consequently, new jobs. At the same time, production and jobs in the area of ICT and GT will be secured and the necessary expansion of renewable energy production is not endangered by the scarcity of essential materials.

The interdisciplinary approach will lead to close pan-European cooperation among science and industry and secure Europe's leading role in environmental technology. The intense networking opportunities will foster, nurture and develop early-stage researchers – the next generation of brilliant minds.

The recovery and the valorisation of WEEE comprise the optimisation of WEEE collection systems, reducing the amounts of mislead WEEE streams, hereby improving the situation in developing countries where its inadequate treatment is leading to severe environmental and sanitary problems. In addition, the project consolidates the actual state of research and determines a common European baseline and optimises the efficiency of research in this field, avoiding uncoordinated parallel investigation efforts.

The contribution to technical and scientific knowledge will support the actions of different parties involved in EEE design and production, as well as in the management of WEEE, thus increasing the impact of research and development results on policy-makers, regulatory bodies and decision-makers as well as the private sector.

## Objectives & Impacts

A KEY objective of the ReCrew Project is the consolidation of knowledge and the development of a common scientific baseline for joint research and cooperation of European and international scientists and stakeholders. This to promote the recovery of CM from WEEE for a sustainable supply for innovative European industrial sectors and the creation of opportunities for exchange, especially for early-stage researchers throughout Europe. The common development of recovery processes will promote a sustainable strategy for waste and resources management. The WGs have been formed and research tasks have been assigned – the key deliverables from the Project are expected to include a report on the state of research and gap analysis; a working paper on the best available technologies for WEEE; and guidelines on WEEE management. ■