European Innovation Partnership on Raw Materials

Application for a Raw Materials Commitment

**Innovative Hydrometallurgical processes to recover precious and critical metals from WEEE and other HighTech products**

Acronym:
HydroWEEE

Links to the Strategic Implementation Plan:
- **I. Technology Pillar**
  - I.B Priority Area: Technologies for primary and secondary raw materials’ production
    - Action area n° I.5: Recycling of raw materials from products
      - 1) End-of-life products recycling
- **II. Non-Technology Pillar**
  - II.B Priority Area: Improving Europe's waste management framework conditions and excellence
    - Action area n° II.5: Optimised waste flows for increased recycling
      - 4) Innovative approaches and infrastructures for reuse and recovery of end-of-life consumer products
    - Action area n° II.7: Optimised material recovery
      - 1) European standards for treatment of WEEE maximising the recovery of high value and critical raw materials
  - II.C Priority Area: Knowledge
    - Action area n° II.9: Possible EIT Knowledge and Innovation Community
      - 3) SME network

Objectives of the commitment:

Electr(on)ic products and other HighTech products like cars, PV modules, .... consist of a high amount of diverse metals. According to a survey of Sullivan e.g. mobile phones have a metal content of 25%. Though the absolute amounts of each device regarding the most valuable elements are low (16g Cu, 0.35g Ag, 0.0034g Au, 0.015g Pd, and 0.00034g Pt) this adds up to e.g. 0.35t of platinum based on estimated 1 billion cell phones in 2010.

Regardless of their low amount in specific electronic components there are some metals which are highly preferred or are even essential for the present technology

Recycling of the “critical metals” according to RMI will contribute to:
- reducing the dependency of permanent supply of essential resources from non-EU countries
• boosting the European economy (cost saving for manufacturing industry, more profit in recycling companies, especially for SMEs through the mobile plant,...)
• minimizing the toxic burden on and around the sites of mining, processing and manufacturing
• solving a waste issue of these consumer products

Description of the activities:

The first FP7-Research for SMEs project HydroWEEE (01.03.2009 – 28.02.2012) dealt with the recovery of rare and precious metals from WEEE including lamps and spent batteries by hydrometallurgical processes. The idea has been to develop a mobile plant using hydrometallurgical processes to extract metals like yttrium, indium, lithium, cobalt, zinc, copper, gold, silver, nickel, lead, tin in a high purity (above 95%). By making this plant mobile (in a container) several SMEs can benefit from the same plant at different times and therefore limit the necessary quantities of waste as well as investments. By making the processes universal several fractions (lamps, CRTs – Cathode Ray Tubes, LCDs – Liquid Crystal Displays, printed circuit boards and Li-batteries) can be treated in the same mobile plant in batches. This reduces the minimum quantity per fraction per recycler even more. In addition these innovative HydroWEEE processes produce pure enough material that they can be directly used by end-users for electroplating and other applications. Because of this 2 levels of intermediaries from today (bigger recyclers and secondary material processors) will be bypassed. This will make the SMEs much more competitive than today and reverse the general trend to bigger, multinational companies in the waste management sector.

In addition this will decrease the environmental impact substantially as
• on the one hand increase substantially the resource-efficiency in Europe as a lot more precious and rare material will be recycled economically (that are currently lost) and by that decrease the amount of mining as well as landfiling and
• on the other hand the mobile plants will be transported to the recyclers’ locations instead of shipping large quantities of materials through whole Europe as it is done today.

In the previous research project a mobile pilot plant with a reactor size of 1 m3 has been developed that has been and still can be used for process development and optimisation. However in order to really demonstrate the stability, financial credibility and resource-efficiency of our innovative processes an industrial stationary plant as well as a full-scale mobile plant (4,5 m3 reactor) are currently built in our second FP7 ENV project HydroWEEE Demo (01.10.2012 – 30.09.2016). The first industrial stationary plant will go live at partner Relight in Italy in February 2014 and the first industrial mobile plant will start operating at our partner Greentronics in Romania in March/April 2014.

The demonstration objectives will have been successfully achieved when the stationary plant has been continuously run for at least 18 months giving financial profits as well as environmental benefits without any social or whatsoever shortcomings. The same success factors apply for the mobile plant being run for the same 18 months at minimum 5 locations in at least 3 countries in Europe.

In addition the previously developed processes of extracting yttrium, indium, lithium, cobalt, zinc, copper, gold, silver, nickel, lead, tin will be improved even more and new processes to recover additional metals which are still in this fractions (e.g. Cerium, Platinum, Palladium, Europium, Lanthanum, Terbium, …) from WEEE or other sectors (e.g. automotive, …) as well as innovative solutions for the integrated treatment of waste water as well as solid wastes will be developed.

Finally also the necessary pre-treatment technologies will have to be optimized to fit in an optimal way to our HydroWEEE processes and close the lack of mechanical processing equipment at the average European recycling SME. Therefore we again envisage mobile pre-treatment plants for
lamps, CRTs, LCDs, Li-batteries (highly explosive), ... to prepare an input granulate with about 1 mm particle size.

Summarized the objective of the HydroWEEE Commitment is to build 2 industrial scale, real-life demonstration plants (one stationary and one mobile) in order to test the performance and prove the viability of the processes from an integrated point of view (technical, economical, operational, social) including the assessment of its risks (including health) and benefits to the society and the environment as well as remove the barriers for a wide market uptake.

**Description of the expected impacts:**

Currently several HydroWEEE partners are founding a joint spin-off company ResouTech Resource Efficient Technologies OG in Vienna, Austria to market the developed processes widely. We will offer our own mobile plants as a service to SMEs, sell tailored stationary plants to larger recyclers and also license the technology to regions in the world where we will not become active ourselves. We see a market for 50-100 stationary as well as mobile plants until 2020. This represents roughly a turnover of 50-150 million € and the creation of about 200-300 skilled and meaningful jobs in Europe. In addition these 50-100 plants will convert about 15.000 – 30.000 tons of mostly dangerous waste into 2.000 – 5.000 tons of precious and critical metals annually. Several WEEE collective systems (Remedia IT, ECOTIC RO, UFH AT, ...) as well as the European WEEE Forum itself have already shown a lot of interest to promote our mobile plant to its recycling partners in their own interest to increase the recycling percentages as well as decrease their recycling costs. Finally for selling tailor-made stationary plants also bigger recyclers like Electrorecycling, Coolrec, Indumetal and Sims have shown already strong interest and will act as first pilot customers outside our consortium. Recycling machinery builders like ELDAN Recycling (DK) and MRT (SE) have offered to include our plant in their sales portfolio and sell it together with their solutions for the pre-treatment. We have already signed a MoU with Solvay Rhodia to buy our rare earth metals.

Summarized HydroWEEE will boost European competitiveness by applying novel processes for improved resource efficiency by extracting rare and precious metals from WEEE and other sectors. Furthermore it will reduce Europe’s dependence on foreign raw material sources and by that make the European industry more independent and less vulnerable.

**Expected innovation outcomes:**

- New products to the market
- New processes
- New services
- New technologies
- New business models
- New ideas to the market

**Comments:**

New research and innovation will concentrate on:
1. the optimisation of the processes of extracting Yttrium, Indium, Lithium, Cobalt, Zinc, Copper, Gold, Silver, Nickel, Lead, Tin (e.g. for lamps: reaction times for leaching, filtration, precipitation settling and another filtration; solid/liquid ratio, amount of oxalic and sulphuric acids, temperature, amount of washing water, roasting temperature, ...);
2. new processes to recover additional metals (e.g. Platinum, Palladium, Europium, Lanthanum, Cerium, Terbium, ...) from the same 5 fractions (CRT, lamps, LCDs, Li-batteries and printed circuit
boards) from WEEE or other sectors (e.g. automotive and industrial catalysts) will be developed always with the aim to find physical-chemical processes suitable for SMEs and a mobile plant;

3. innovative solutions for the integrated treatment of waste water and the other solid wastes will be developed with the aim to obtain maximum re-use of water. Also the interlinkages between the further process optimisation and the treatment of solid and liquid residues has to be further investigated.

Name of the coordinating organisation:
Kopacek KG
Country:
Austria
Entity profile:
Private sector - SME
Role within the commitment:
Coordinator, Business developer, responsible for setting-up and managing the spin-off Company ResouTech, shareholder of ResouTech, investor into mobile plant

Other partners:

Name of partner:
Relight Srl
Country:
Italy
Entity profile:
Private sector - SME
Role within the commitment:
implementation Partner for stationary plant, shareholder of ResouTech, Investor in stationary plant

Name of partner:
ECO RECYCLING S.R.L.
Country:
Italy
Entity profile:
Private sector - SME
Role within the commitment:
Engineering Company, responsible for designing, building and maintaining the mobile and stationary plants, shareholder of ResouTech, Investor into mobile plant

Name of partner:
Greentronics Srl
Country:
Romania
Entity profile:
Private sector - SME
Role within the commitment:
implementation Partner of mobile plant, first test user of mobile plant, Investor into mobile plant

Name of partner: SET Recycling doo  
Country: Serbia  
Entity profile: Private sector - SME  
Role within the commitment: implementation Partner for mobile plant, Investor into mobile plant, second test user of the mobile plant

Name of partner: INSTITUT MIHAJLO PUPIN  
Country: Serbia  
Entity profile: Academia  
Role within the commitment: Research and Engineering Partner for the Automation of the industrial plants

Name of partner: UNIVERSITA DEGLI STUDI DELL'AQUILA  
Country: Italy  
Entity profile: Academia  
Role within the commitment: Research Partner for hydrometallurgy (CRT, lamps, printed circuit boards), Scientific Leader of the Commitment

Name of partner: UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA  
Country: Italy  
Entity profile: Academia  
Role within the commitment: Research Partner for Li-ion accumulator recycling

Name of partner: UNIVERSITA POLITECNICA DELLE MARCHE  
Country: Italy
Entity profile:
Academia

Role within the commitment:
Research Partner for LCDs and environmental assessments

Existing EU contribution:
Yes
Source:
FP 7

Period to implement the commitment:
Wednesday, 1 January, 2014 to Sunday, 31 December, 2017