



CIRCULAR MATERIALS CONFERENCE

14th September 2022 - Skellefteå

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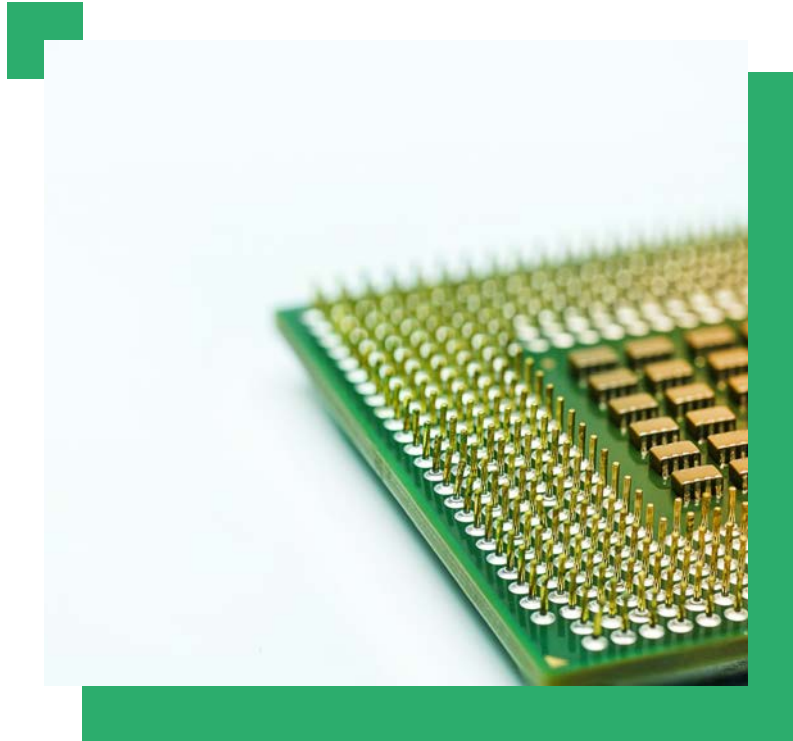
Waste from Electric and Electronic Equipment

Electronic waste is a growing problem in EU and throughout the world.

The total weight of global EEE consumption increases annually by **2.5 million metric tons (Mt)** and WEEE is one of the fastest growing stream (**3-4% per year**).

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WEEE and PCBs

Significant proportion of WEEE is constituted by **PCBs** which represent about **8% by weight** of WEEE collected from small appliances and **3% of the mass** of global WEEE.

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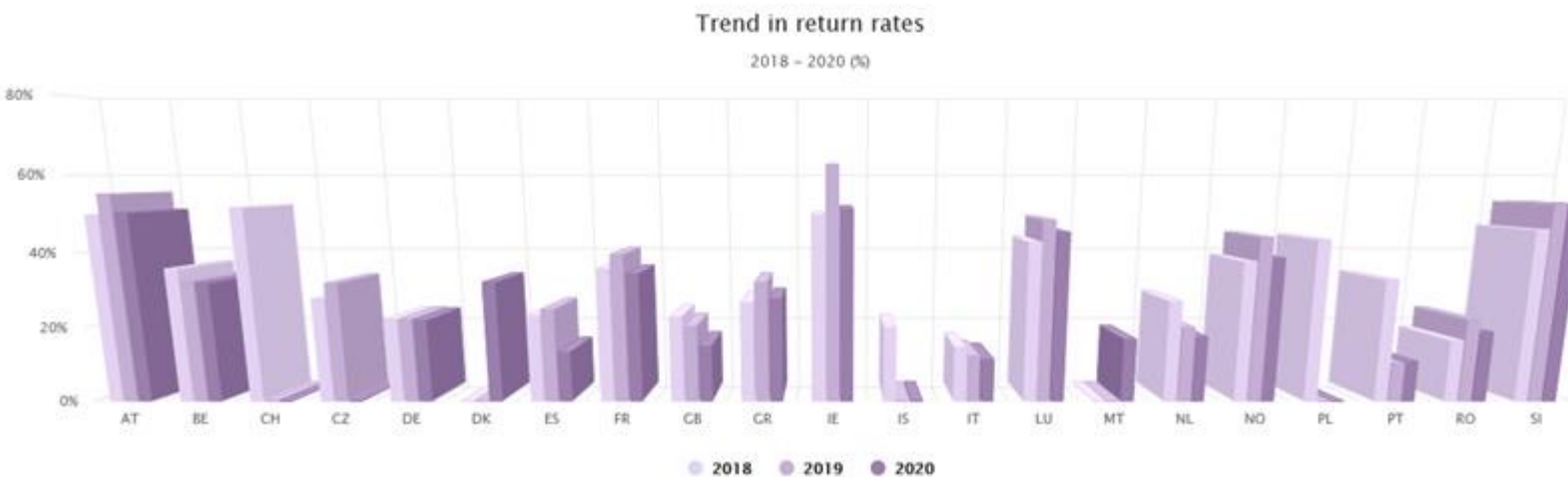
WEEE collection



Rate of return:
quantity of WEEE collected/EEE put on the market



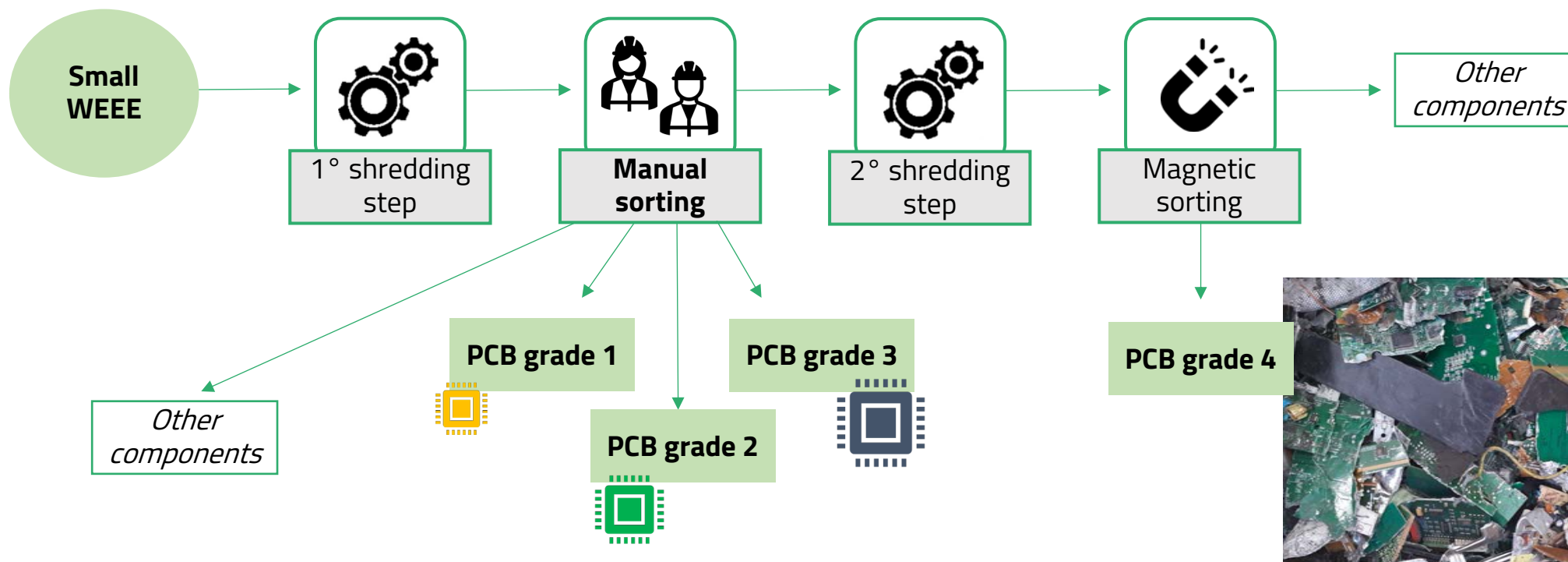
Italy 2020
31.72%



Italy 2020
Small household appliances
11.62%



Current WEEE pre-treatment line to extract PCBs



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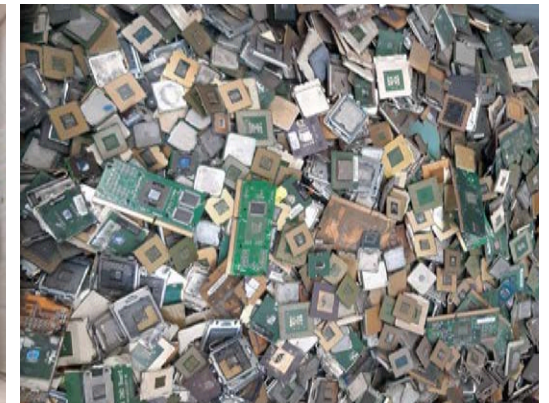




PCBs sorting

At the treatment plant, PCBs are divided in many different categories (**up to 25**):

- Telecommunication PBC, server, peripheral devices, flat screen, hard disk
- PC – Old Generation (big slot)
- PC – New Generation (small slot)
- PCB of II category
- PCB of III category
- PCB from TV and CRT monitors
- PCB from power appliances (i.e., vacuum cleaners)
- PCB parts (not populated)
- Ceramic processors
- Resin processors without metal plate
- Resins processor with pins
- Resins processor without pin
- Golden RAM
- Silver RAM
- RAM with heatsink



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CURRENT SITUATION

PCB recycling

PCBs contain significant amounts of recoverable secondary raw materials such as **copper, gold, silver, palladium** and **platinum**.

PCBs recycling is nowadays strategic for the scarcity or inhomogeneous distribution of these materials on the Earth.

Recycling PCBs presents some issues because of the high content of **epoxy** (30%) and the content of **bromine** (3%).

- *No focus on plastic recycling*



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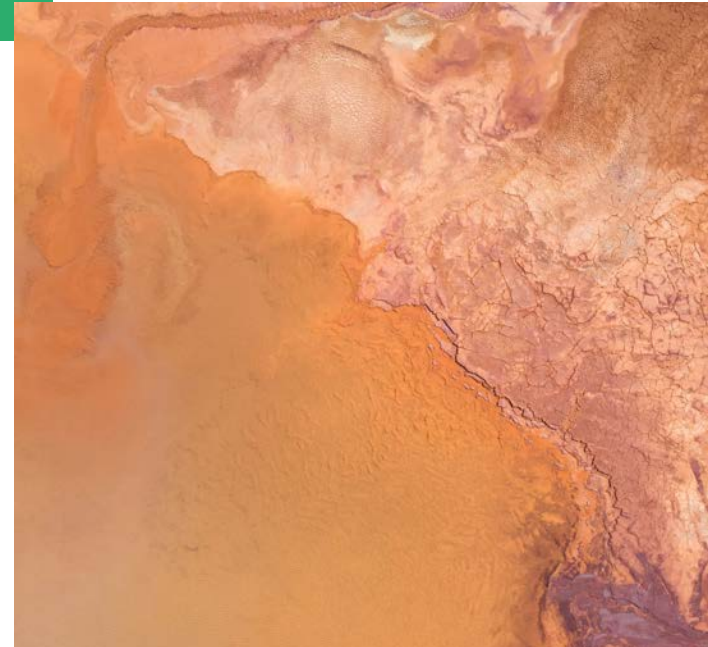


CURRENT SITUATION

Copper market

Limited expansion in operational mines and **complexity of new mines:**

- deeper
- more expensive
- lower ore grades
- higher impurities (more As, Pb, Bi, Hg and other metals)
- increase of shipping costs for copper concentrates due to the marine pollution protocol and transport regulations



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THE PROJECT

Partners



Duration: 2022-2024

Upscaling project

To validate a technology for the **epoxy separation** that facilitates the Raw and Critical Materials (RM & CRM) recovery in the smelter furnace and to valorize the epoxy from the PCBs through chemical recycling.

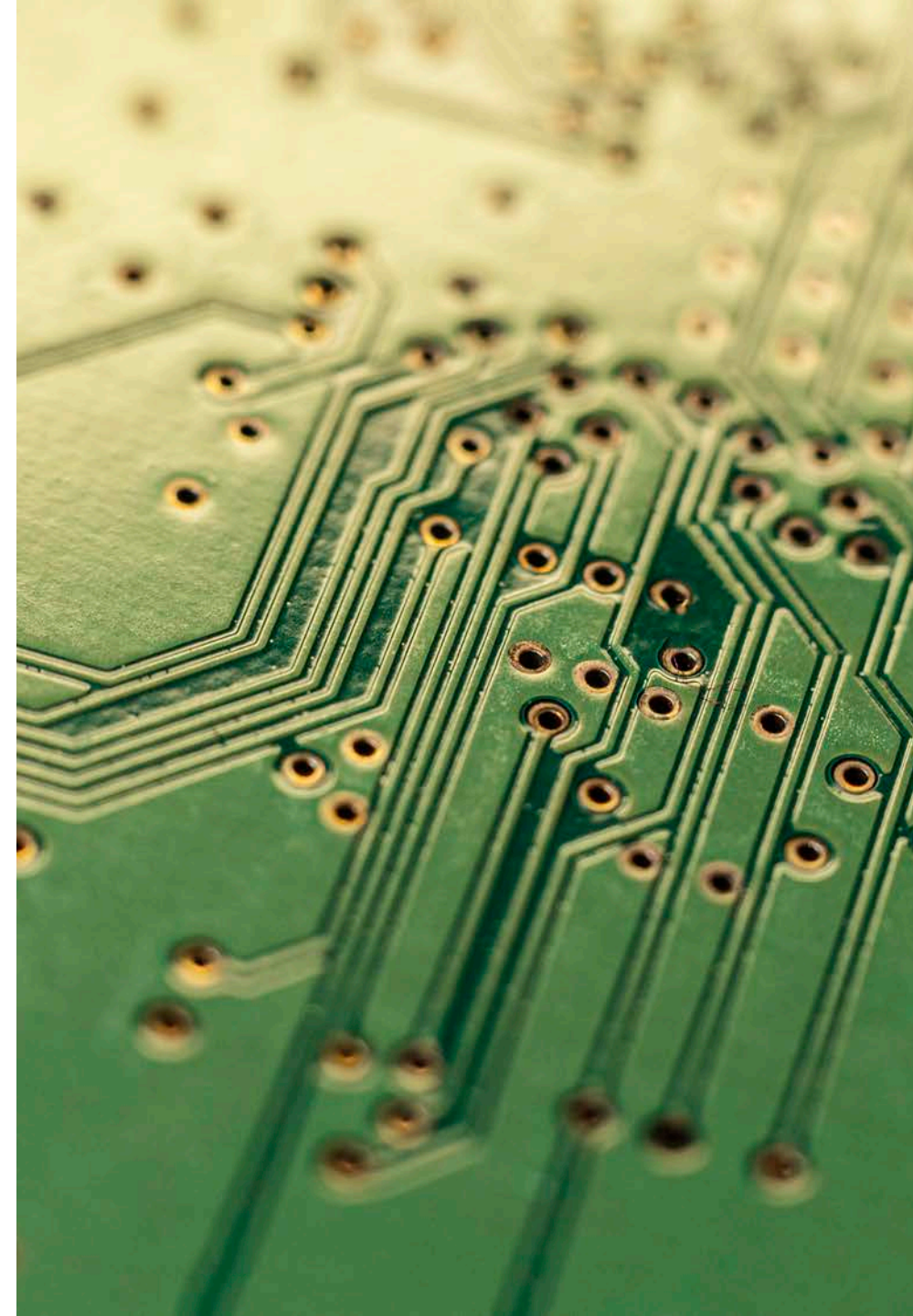
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THE PROJECT OBJECTIVES

- Increase the metal treatment capacity of smelting furnaces
- Reduce the PCBs recycling process CO₂ footprint and simplify the emission treatment activities
- Study ways to recover and valorise the epoxy
- Test innovative collection Eco-point to increase WEEE collection
- Increase the value of WPCBs on the market

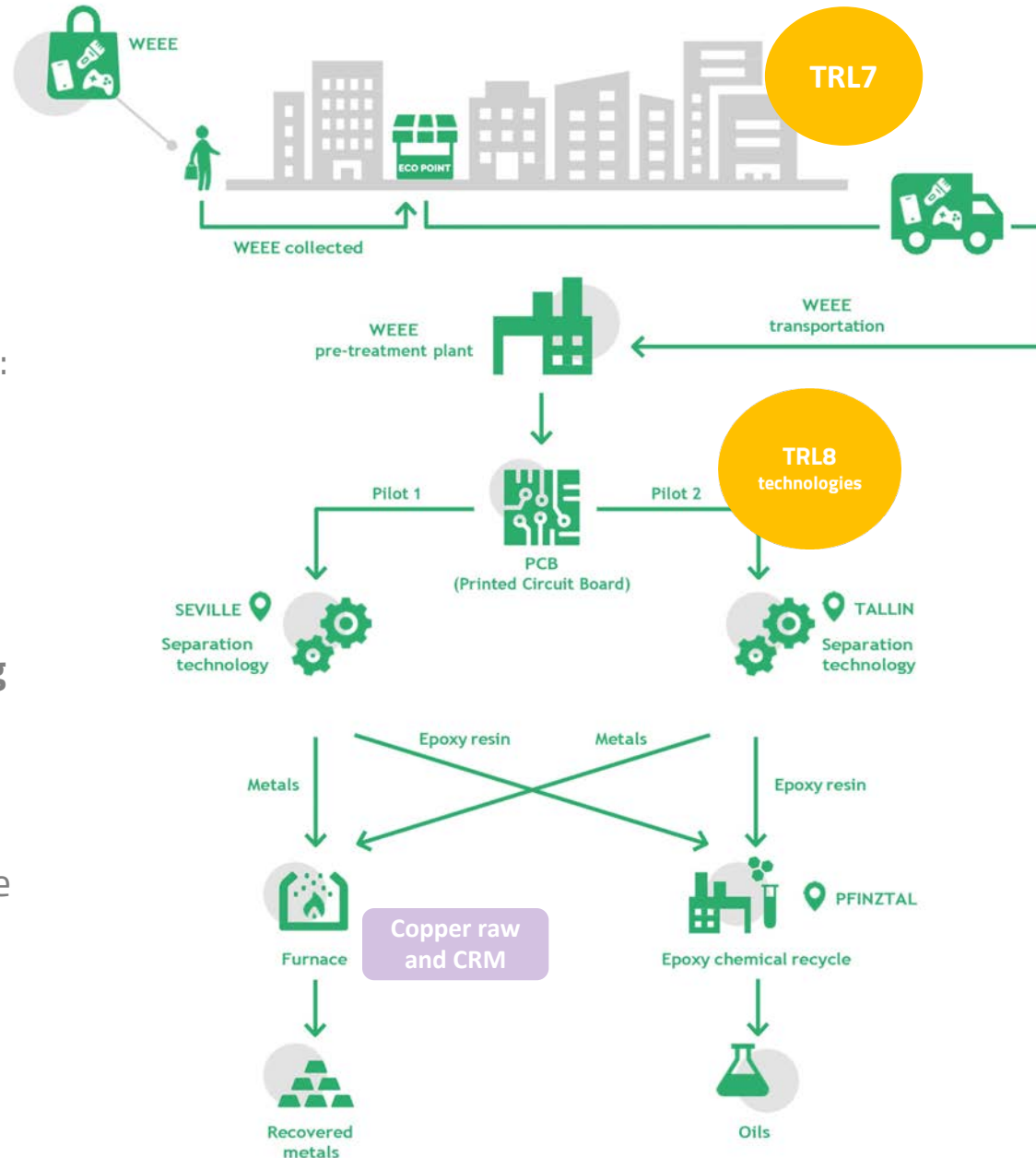
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The project will execute different **pilots** to simulate the process for the **separation** of plastic from the metal contained in the PCBs: the one run by Atlantic Copper, with the support of the Innovation Centre of the Seville University (**AICIA**), and the one run by Tallin University (**ImpactPCB**).

Fraunhofer, instead, will take care of the optimization of the epoxy **chemical recycling** process through a dedicated pilot.

In this framework, ERION will develop and set up innovative **eco-points** to test their effectiveness in enhancing the collection rate of WEEE.



ECO-POINT

WEEE collection point dedicated to the collection of **small household appliances** (such as smartphone, tablet, laptop...).

The Eco-point will be **small-medium sized**, and it will represent an **alternative** to the traditional municipal collection points.

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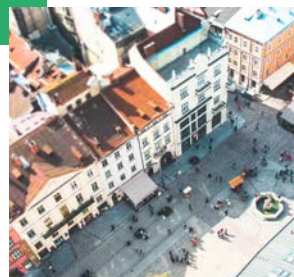
AWARENESS RAISING and EDUCATION

Communication and formative initiatives will be performed at the Eco-point. Information and educational campaigns on sustainability will take place.



MONITOR

Data collection activities will be performed, focusing on WEEE amount, condition, typology, environmental benefits generated.



EASY DISPOSAL

Pay attention to the citizens' needs, e.g., no long distances to reach municipal points, appropriate size containers, long opening hours, information about data protection issues.



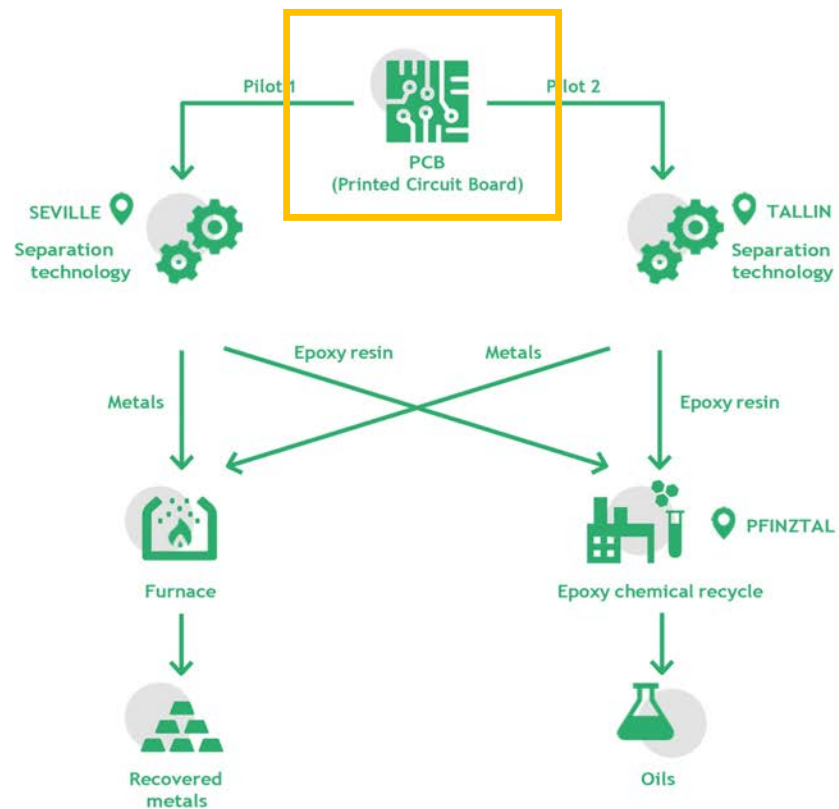
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Feedstock characterization



1. EOL DESKTOPS

WPCB High grade



2. EOL LCD TVS

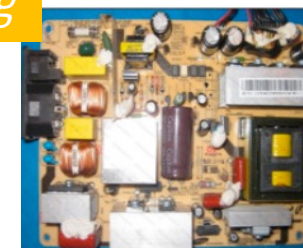
WPCB Medium grade



3. CRT TVS

WPCB Low grade

Manual dismantling



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Feedstock characterization

Lab analysis are needed.

SECONDARY SOURCE - WEEE (IN GROUPS ACCORDING ITALIAN LAW)	KEY – COMPONENT FOR PGMs &PM	Gold (Au) mg/kg	Silver (Ag) mg/kg	Platinum (Pt) mg/kg	Palladium (Pd) mg/kg
CRT TV & Monitors (WEEE Group R3)	WPCB, LOW GRADE	12	300		<1
LCD TV & Monitors (WEEE Group R3)	WPCB-LCD, MEDIUM GRADE	180	450	<1	
LCD TV & Monitors (WEEE Group R3)	WPCB, LOW GRADE	50	300	<1	
Desktops (WEEE Group R4)	WPCB, HIGH GRADE	100-150	300-600	<1	

Source: TREE Internal Database



1. EOL DESKTOPS



2. EOL LCD TVS



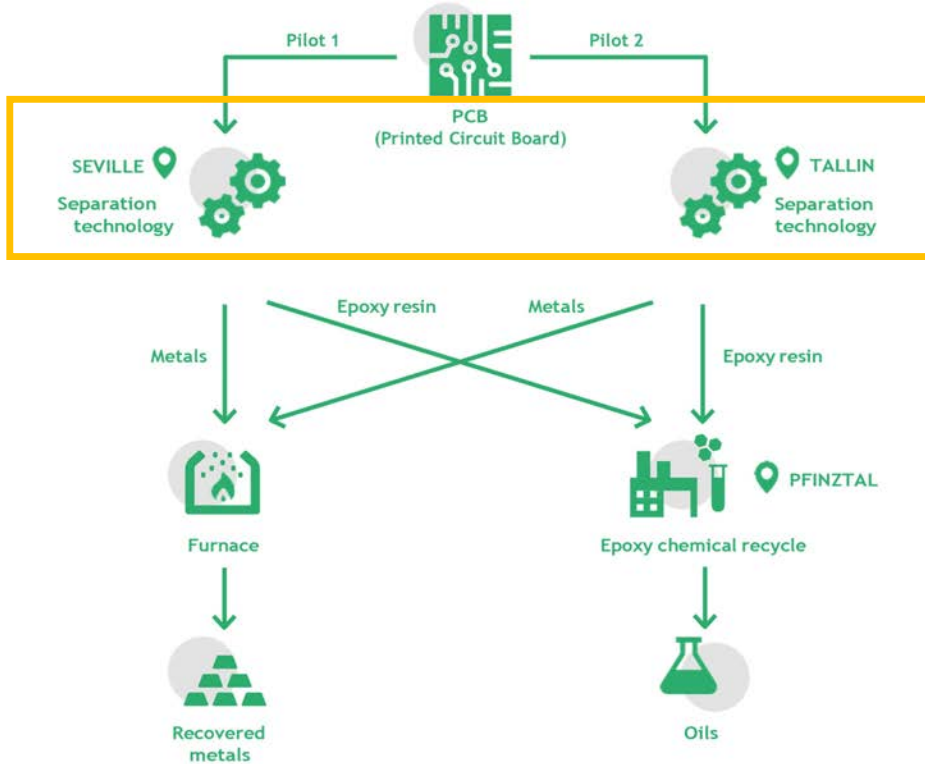
3. CRT TVS



There is no average scrap composition.

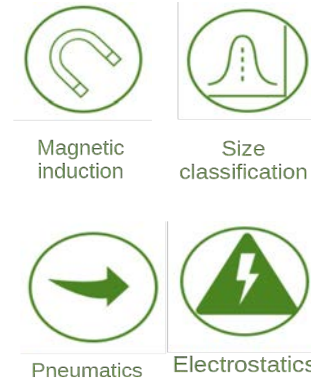


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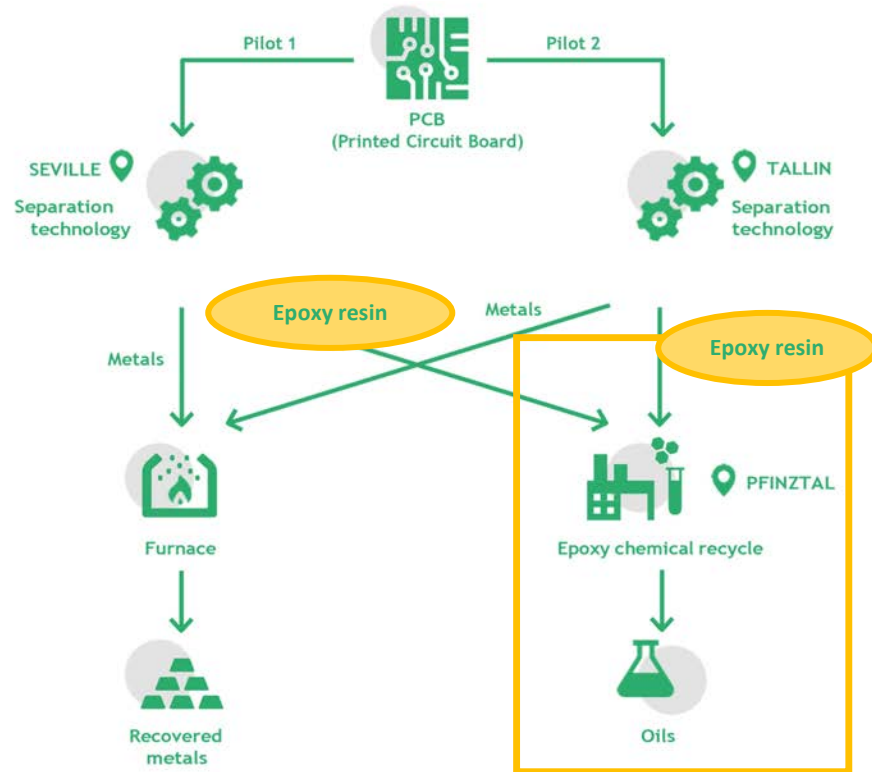
Design and development of **SEPARATION SOLUTIONS:** combination of different technologies to obtain metals and plastic.

- milling at different temperatures
- flotation
- pneumatic separation
- magnetic separation
- electrostatic separation



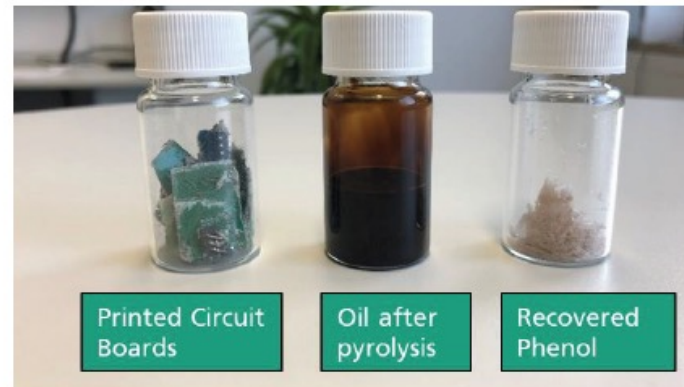
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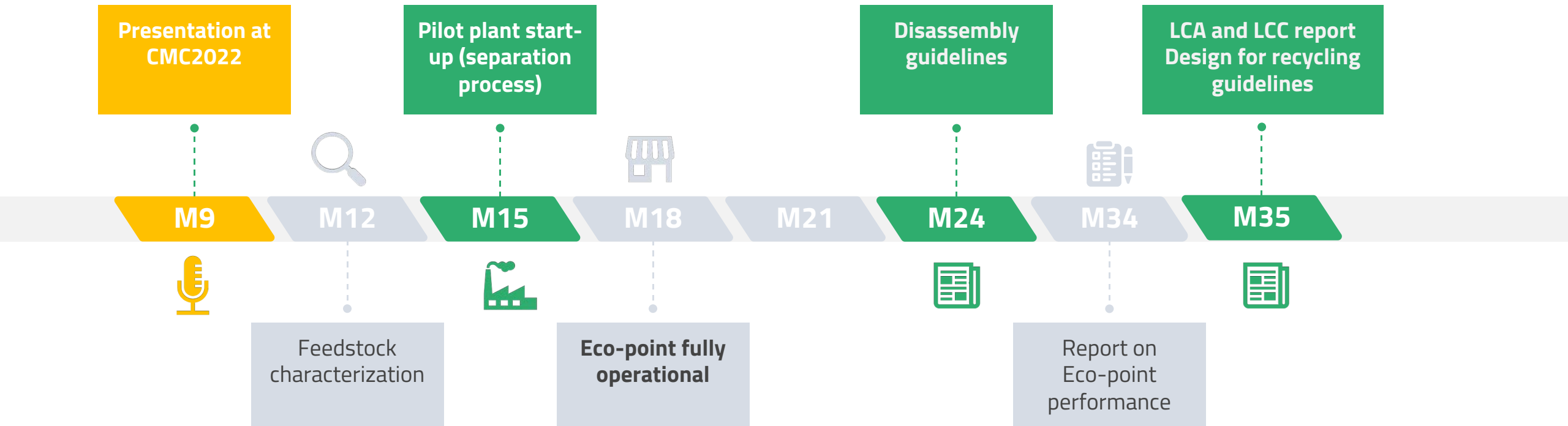
Epoxy valorization

- Starting from the results of the projects **agendta+** and **iCycle**
- Pyrolytic** methods to sort residues: high content of aromatics in pyrolysis oil
- Pure fraction of chemicals (Benzene, toluene, styrene, phenol...)
- Recovery of **oil** and **gas** for energy recovery.



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Next steps



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Re-cycling of Epoxys from Nonferrous E-Waste

Thank you!

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