From Waste to Raw Material: Towards a Profitable Circular Model for WEEE Plastics in Colombia

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Agenda

1. POPs and WEEE
2. WEEE Plastics Pilot Projects
3. Lessons Learned

Persistent Organic Pollutants (POPs) Project Unit

Experience: 2013 – 2026

5 projects implemented (GEF Trust Fund)

Lead Agency: UNDP

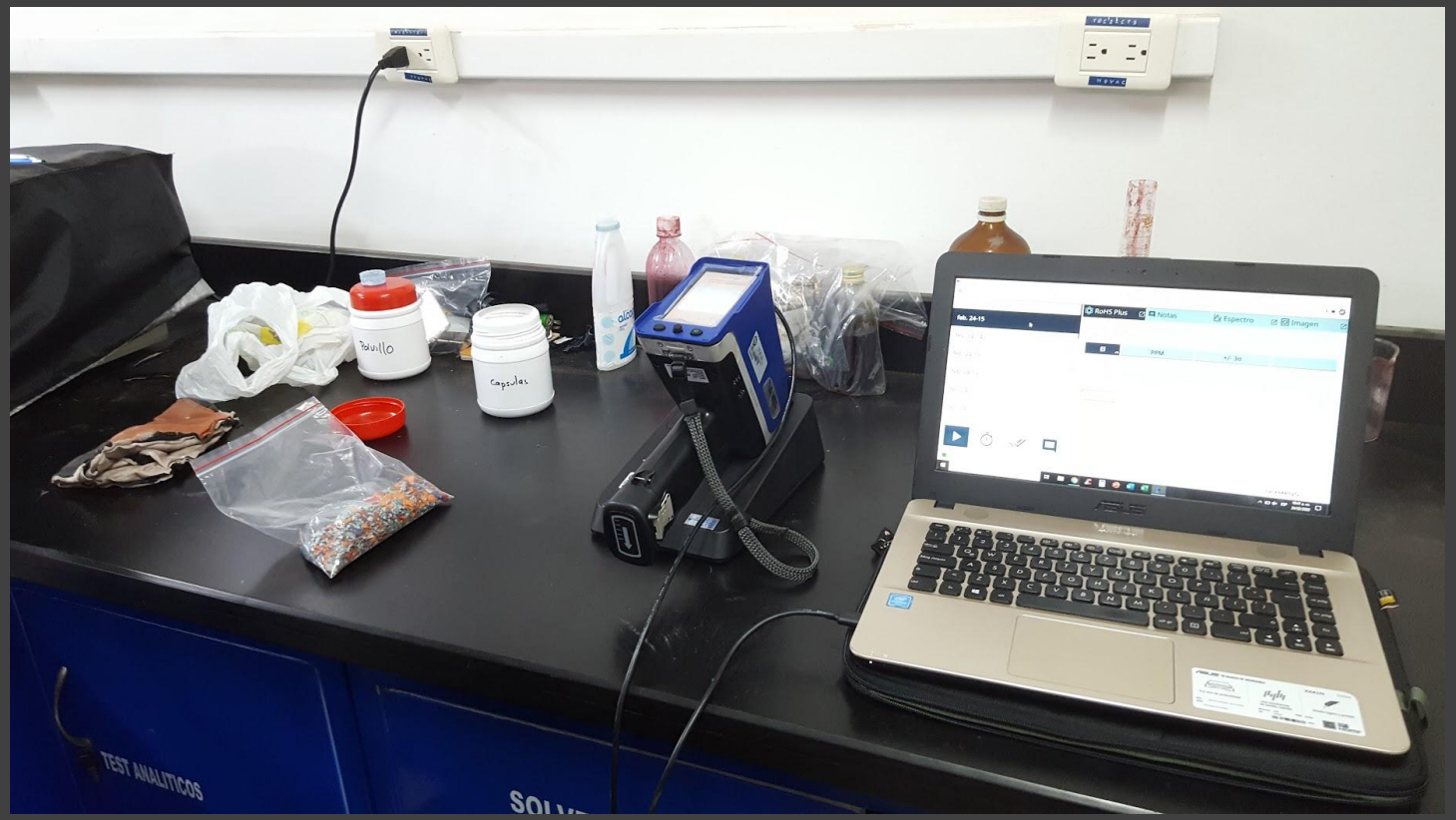
Implementing Partner: **Ministry of Environment and Sustainable Development**

https://quimicos.minambiente.gov.co/cop-uso-industrial/

WEEE Plastics Project Objectives (2017-2025):

To identify, separate, and eliminate POP-contaminated plastics from the WEEE stream

- Identify alternatives for the elimination of POP-contaminated plastics
- Develop a practical method to identify POP-contaminated plastics
- Establish an efficient procedure for separating POP-free plastics



Project Stages

1. Support from SRI (2017)

2. Laboratory stage (2017-2019)
XRF + GC

3. First pilot project (2019-2022)
5 facilities (2,000 tonnes)

4. Second pilot project (2023 - 2025)
9 facilities (2,200 tonnes)

SRI SUSTAINABLE RECYCLING INDUSTRIES

Procesamiento de plásticos de RAEE

Manual práctico

Diciembre, 2019

step
solving the e-waste problem

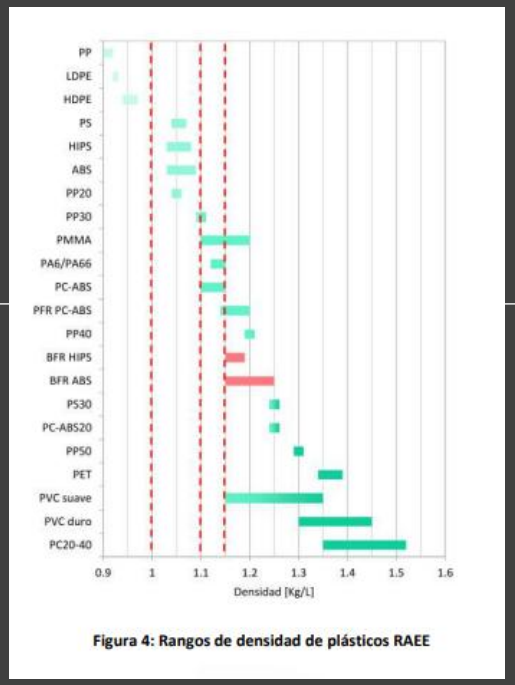
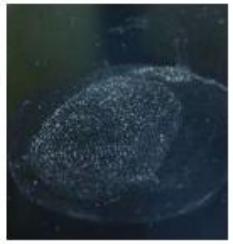
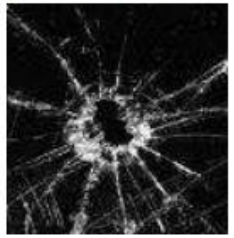


Figura 4: Rangos de densidad de plásticos RAEE

Reacción "pegajosa" a los solventes

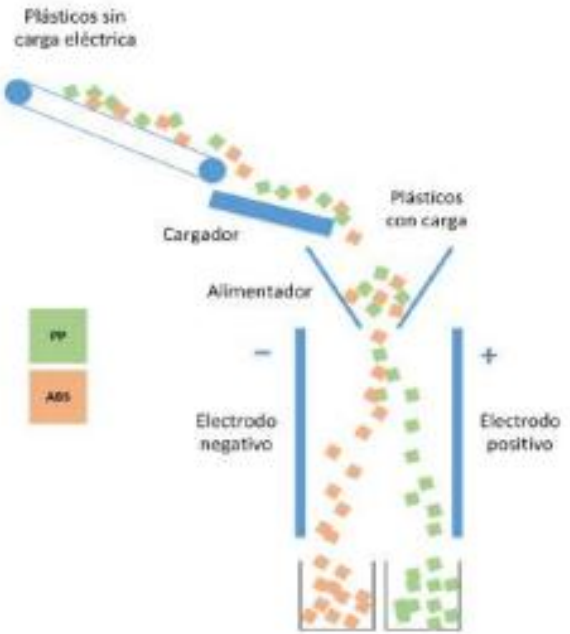


Depósito blanco causado por la reacción de acetona con PC



PS roto

Dispositivo portátil de identificación de plástico



Waste Management
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Research Paper

Chromoproduct approach to achieve environmentally sound management of e-waste plastics: Colombian project case

Andrés Ramírez Restrepo [a b 1], Brenda Natalia López Niño [c 2], Edwin Camelo Martínez [a b 3], Carolina Ramírez García [a b 4]

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https://doi.org/10.1016/j.wasman.2024.02.049 Get rights and content

WEEE recycling profile:

- Visual/manual sorting
- Mainly manual dismantling
- Emerging mechanized processes

Size (tonnes /month)

- Small facilities: ~10
- Large facilities: ~100

Workforce profile:

- High absenteeism and staff turnover
- Low-skilled / untrained labor

Advantages:

- Visual / intuitive
- Turnover resilient
- Data-driven
- Fast and accurate
- No specialized equipment required
- Covers BDEs and SCCPs

Key characteristics:

- Main color
- WEEE type

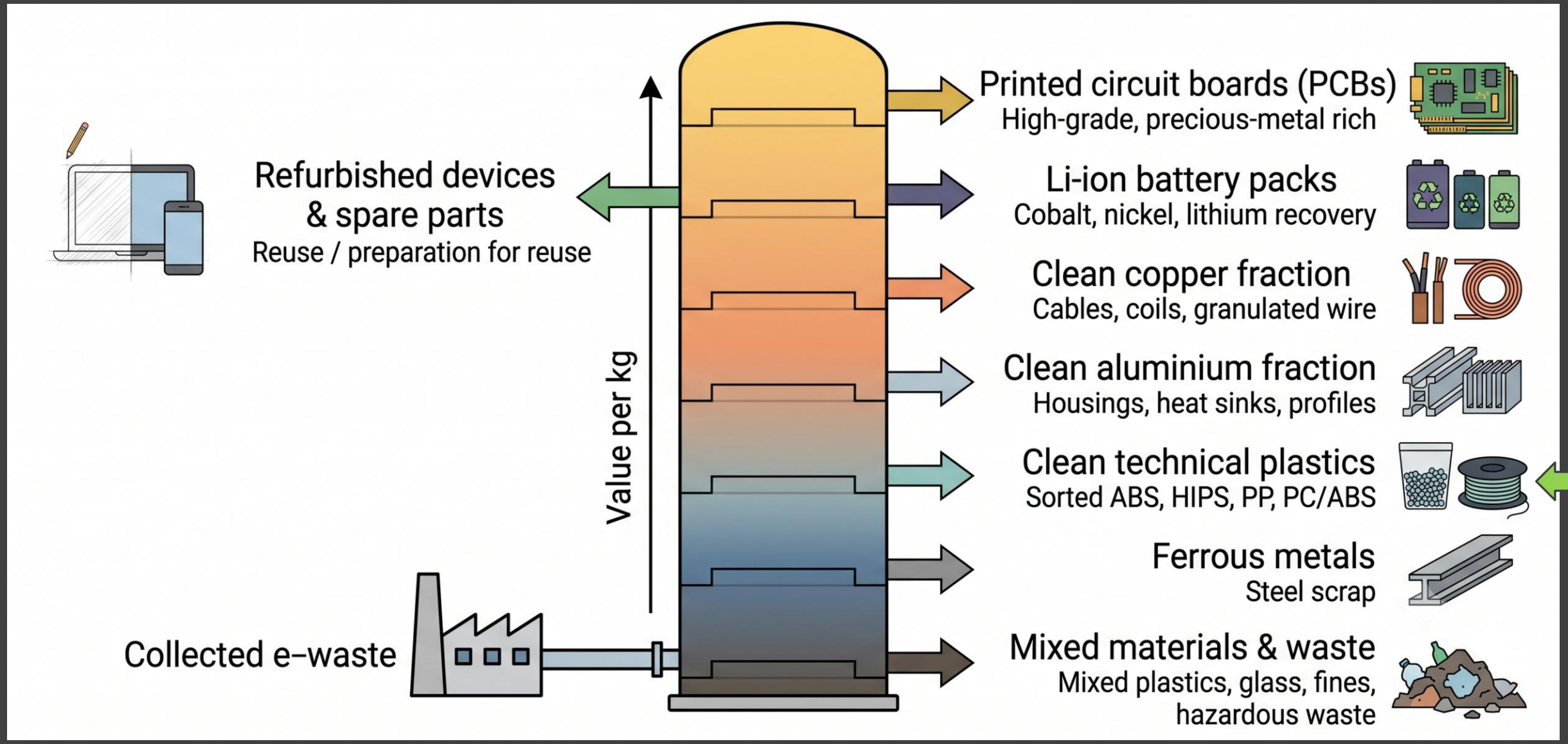
Project results

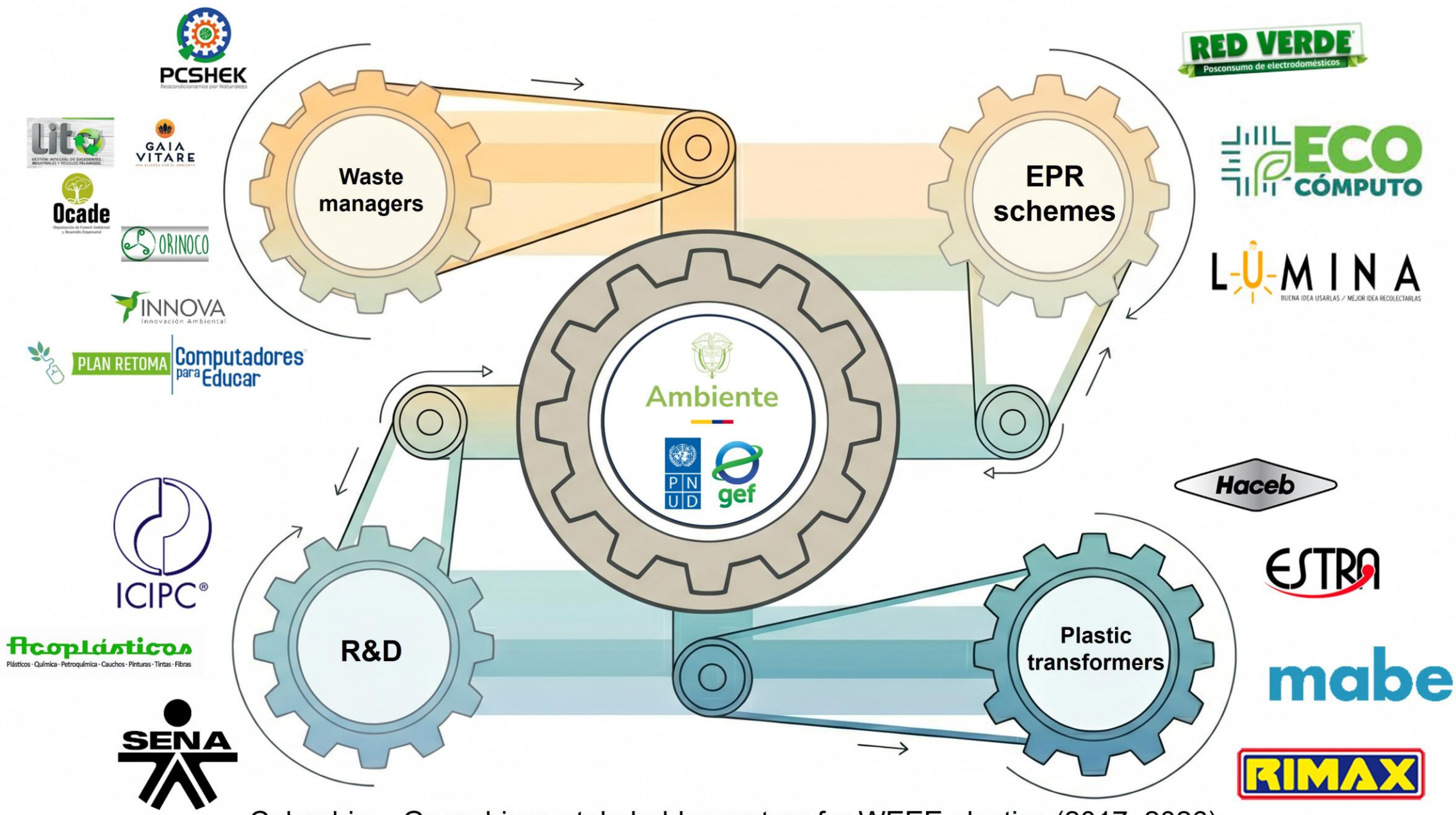
- 150 tonnes POP-contaminated plastics were co-processed
- 20,000 XRF screening tests
- 70 GC-MS confirmatory analysis
- 11 WEEE recycling companies involved
- 375 personnel trained

Once POP-contaminated plastics are removed from the WEEE value chain...

What is the next step for POP-free plastics?

Shifting the paradigm of WEEE plastics recycling


Refurbished devices & spare parts
Reuse / preparation for reuse
Value per kg
Collected e–waste
Printed circuit boards (PCBs)
High-grade, precious-metal rich
Li-ion battery packs
Cobalt, nickel, lithium recovery
Clean copper fraction
Cables, coils, granulated wire
Clean aluminium fraction
Housings, heat sinks, profiles
Clean technical plastics
Sorted ABS, HIPS, PP, PC/ABS
Ferrous metals
Steel scrap
Mixed materials & waste
Mixed plastics, glass, fines, hazardous waste



Colombia – Gear-driven stakeholder system for WEEE plastics (2017–2026)

Technical Guidelines

20 Technical Data sheets

4 Specialized Training sessions

17 Plastics Processing Pilot Trials

2024

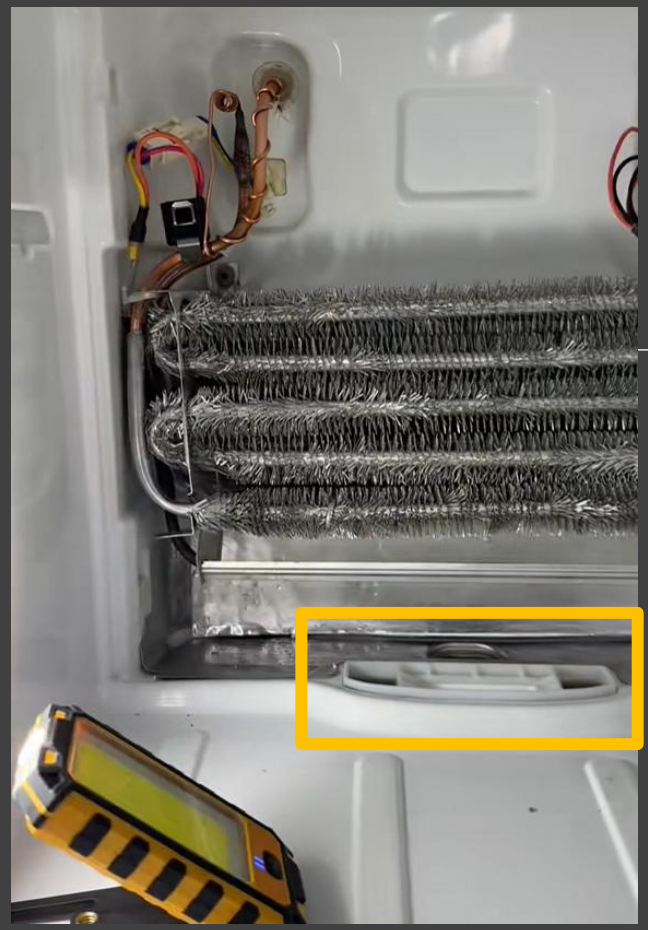
Plastic: ABS (black)

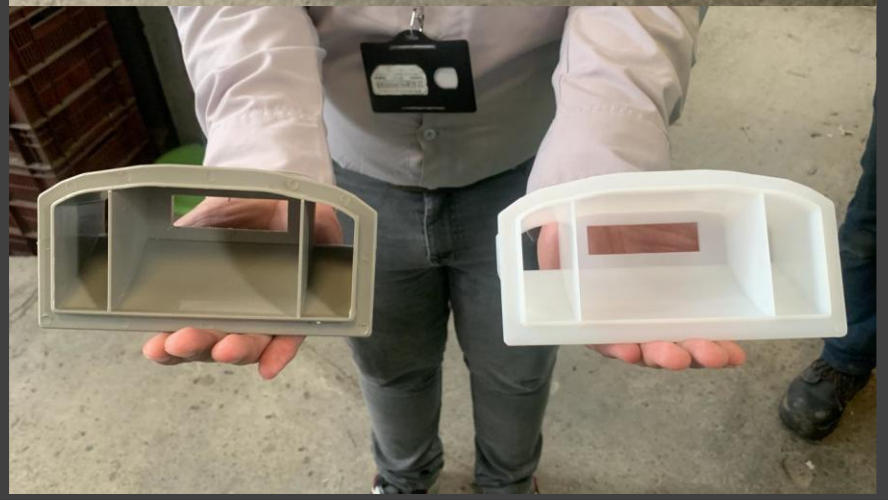
Client: Large home appliances producer

Use: Refrigerator door component

Dimensional test: failed

Appearance test: failed





2025

Plastic: ABS (grey + white)

Client: Home appliances producer

Use: Freezer internal component

Dimensional test: passed

Functional test (low Temp.): passed

Appearance test: failed ¿?

2025

Plastic: ABS (black)

Client: WEEE EPR scheme

Use: WEEE collection point

Dimensional test: passed

Appearance test: passed

Functional test: passed

2026

Plastic: HDPE (white)

Client: Plastic pallet manufacturer

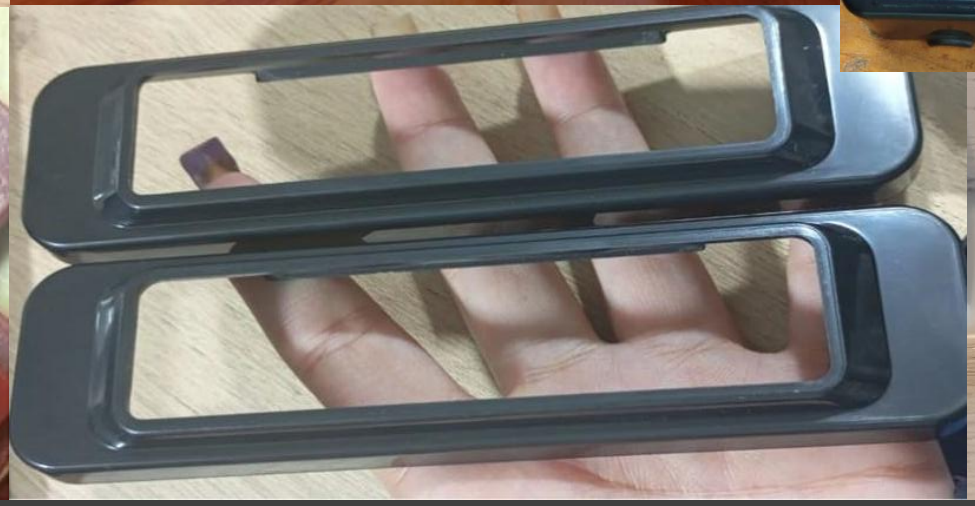
Use: Injection-molded plastic pallets

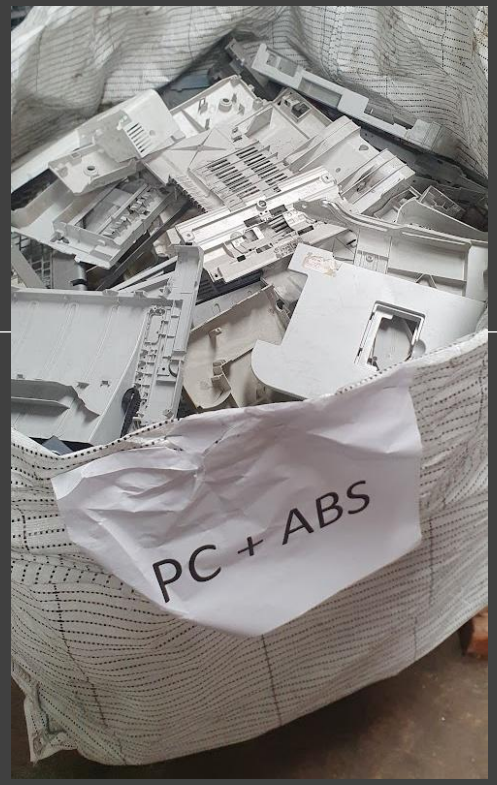
Dimensional test: passed

Functional test: passed

Appearance test: passed

Additional examples...



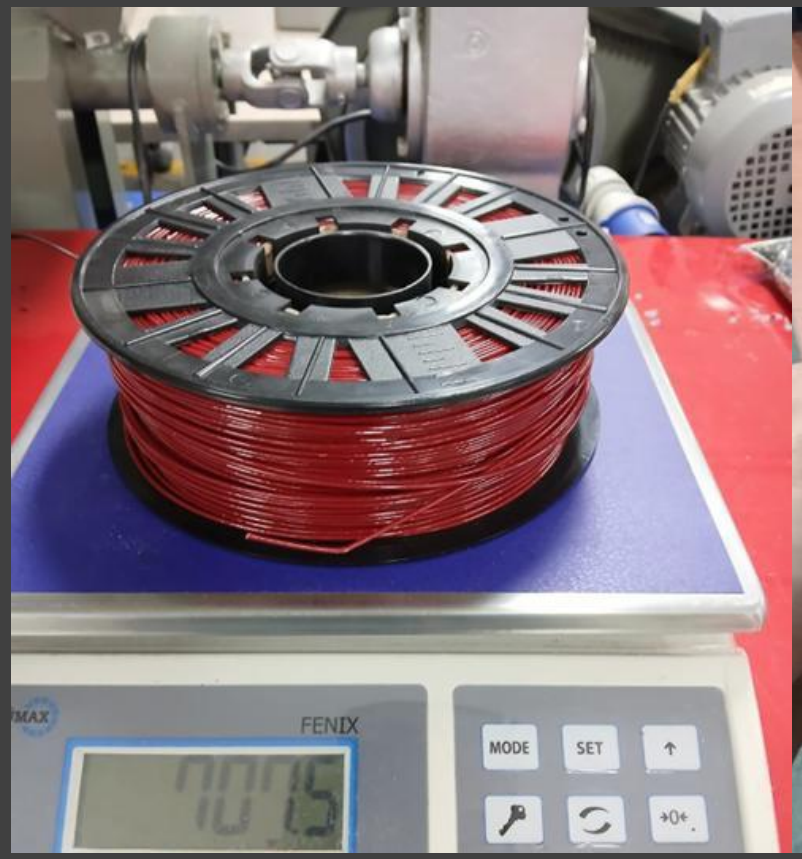


Estimated Price Recovered ABS (USD/kg)

Unsorted-mixed: 0.00 – 0.20

Sorted - flakes: 0.80 – 1.00

Pellets: 1.20 – 1.50



Plastic: ABS (red), ABS/PC (black)

Client: Printing company

Use: 3D printing filament

Dimensional test: passed

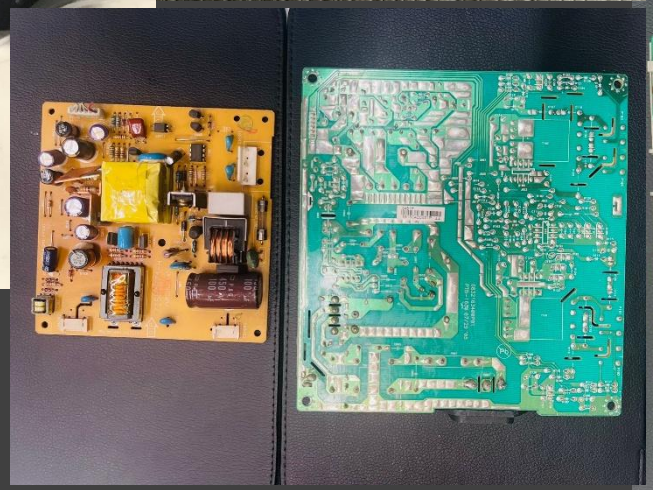
Appearance test: passed

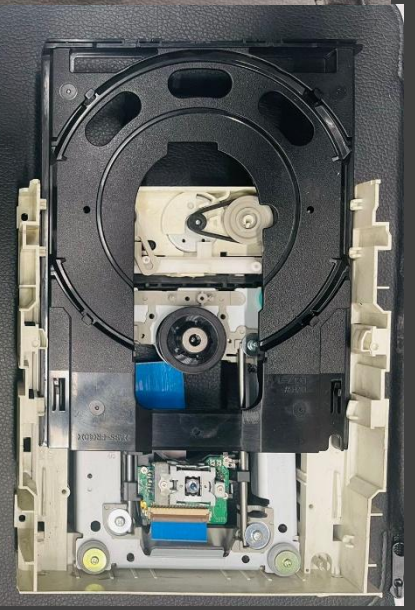
Functional test: passed

“Computadores para Educar”
Public entity that provides learning technologies to public schools nationwide.

Authorized WEEE manager since 2010

Recovery of components and sorted plastics





From WEEE to STEM education kits

From WEEE to STEM education kits

https://www.eltiempo.com/colombia/medellin/colombia-brillo-en-mundial-de-robotica-educativa-roborave-2017-87932

Lessons Learned

Identification of POPs and other hazardous substances is essential for their removal from the value chain.

A paradigm shift in plastic recycling: transitioning from waste to raw material.

Stakeholder cooperation is key to building trust and fostering a sustainable ecosystem.

Lessons learned

Supplier–customer symmetry: A vital learning curve for the plastics industry

Spare parts and 3D printing filament as high-value applications

Traditional e-waste recycling models require a paradigm shift to become circular

Lessons learned

Fire protection must be a priority for WEEE managers due combined risk factors:

- **Combustible materials (e.g., XPS, PUR)**
- **Damaged Li-ion batteries**
- **Electrical risks from processing machinery**

Plan, Protect, Train.

Thank you!

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