

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

Edwin Camelo-Martínez
Project Analyst
United Nations Development Programme
Bogotá, Colombia





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)



Procesamiento de plásticos de RAEE

Manual práctico

Diciembre, 2019

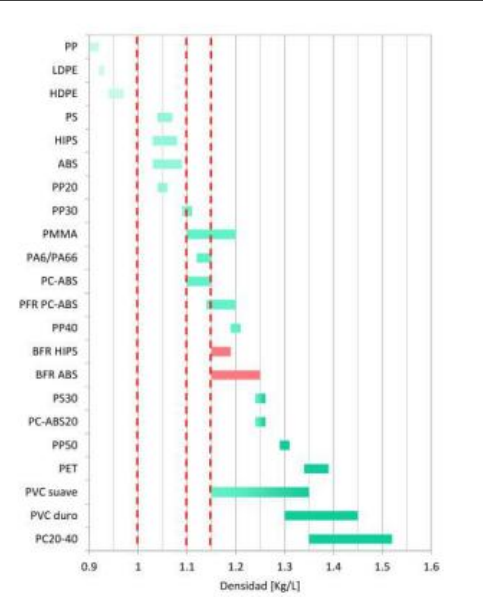


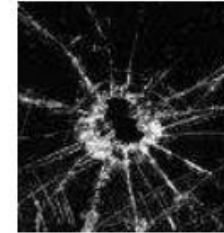
Figura 4: Rangos de densidad de plásticos RAEE



Reacción "pegajosa" a los solventes



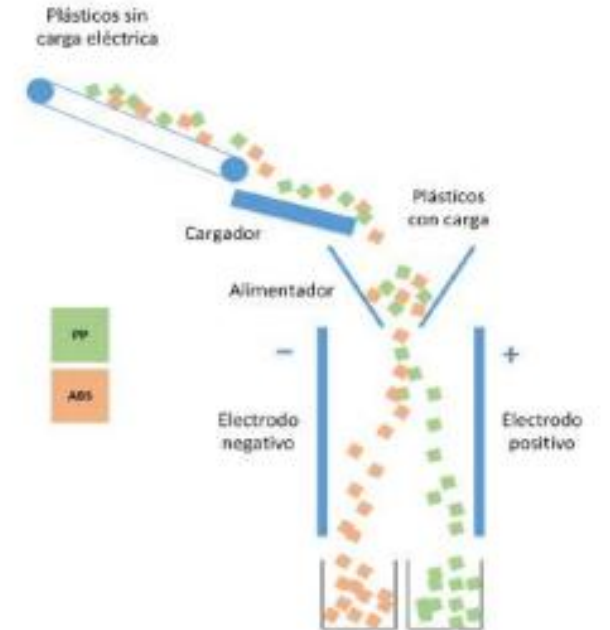
Depósito blanco causado por la reacción de acetona con PC



PS roto



Dispositivo portátil de identificación de plástico





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} 

Show more 

 Add to Mendeley  Share  Cite

<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

LISTADO DE RIESGO ROJO RAEE ACTUALIZADO

Versión 2026



Aparatos que por su contenido de Contaminantes Orgánicos Persistentes (COP), presente en los plásticos, se consideran contaminados y deben tratarse de manera diferenciada.

BOMBILLA FLUORESCENTE  ☐ BLANCO Llamadas ahorradoras, fluorescentes compactas, vienen en espiral o en U.	CÁMARA DE VIDEO  TODOS LOS COLORES Si graba video y toma fotos, se incluye.	CABLES DE DATOS NUEVO  TODOS LOS COLORES Cables utilizados para transmisión de energía y datos dentro de los equipos electrónicos.	EQUIPO DE CALEFACCIÓN  ☐ NEGRO Dispositivo que produce corrientes de aire caliente, a partir de energía eléctrica.	ESTABILIZADOR  ☐ BLANCO ☐ NEGRO Incluye regulador e indicador de voltaje.
MANGUERAS LED  TODOS LOS COLORES Mangueras LED de todos los colores.	MULTITOMA  TODOS LOS COLORES Dispositivo eléctrico también llamado regleta.	PLANCHA DE ROPA  ☐ BLANCO Aparato eléctrico de uso doméstico.	RADIO  ☐ NEGRO No se incluyen los equipos de sonido o minicomponentes.	UNIDAD DE CD/DVD  ☐ NEGRO Incluye las unidades externas así como las que se obtienen en desensamble de CPUs y portátiles.
MEDIDOR ELECTRÓNICO  ☐ BLANCO Incluyen los contadores de energía electromecánicos, analógicos o tradicionales.	UPS  ☐ NEGRO A diferencia del estabilizador, incluye una batería interna.	TELEVISOR CRT  ☐ NEGRO No incluye monitores CRT.		

*Estos colores corresponden a las fracciones de plástico mayoritarias en los aparatos.



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**?

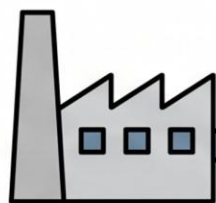


Shifting the
paradigm of
WEEE plastics
recycling



**Refurbished devices
& spare parts**
Reuse / preparation for reuse

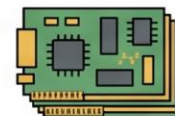
Collected e-waste



Value per kg



Printed circuit boards (PCBs)
High-grade, precious-metal rich



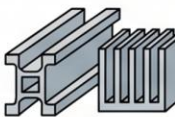
Li-ion battery packs
Cobalt, nickel, lithium recovery



Clean copper fraction
Cables, coils, granulated wire



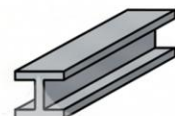
Clean aluminium fraction
Housings, heat sinks, profiles



Clean technical plastics
Sorted ABS, HIPS, PP, PC/ABS

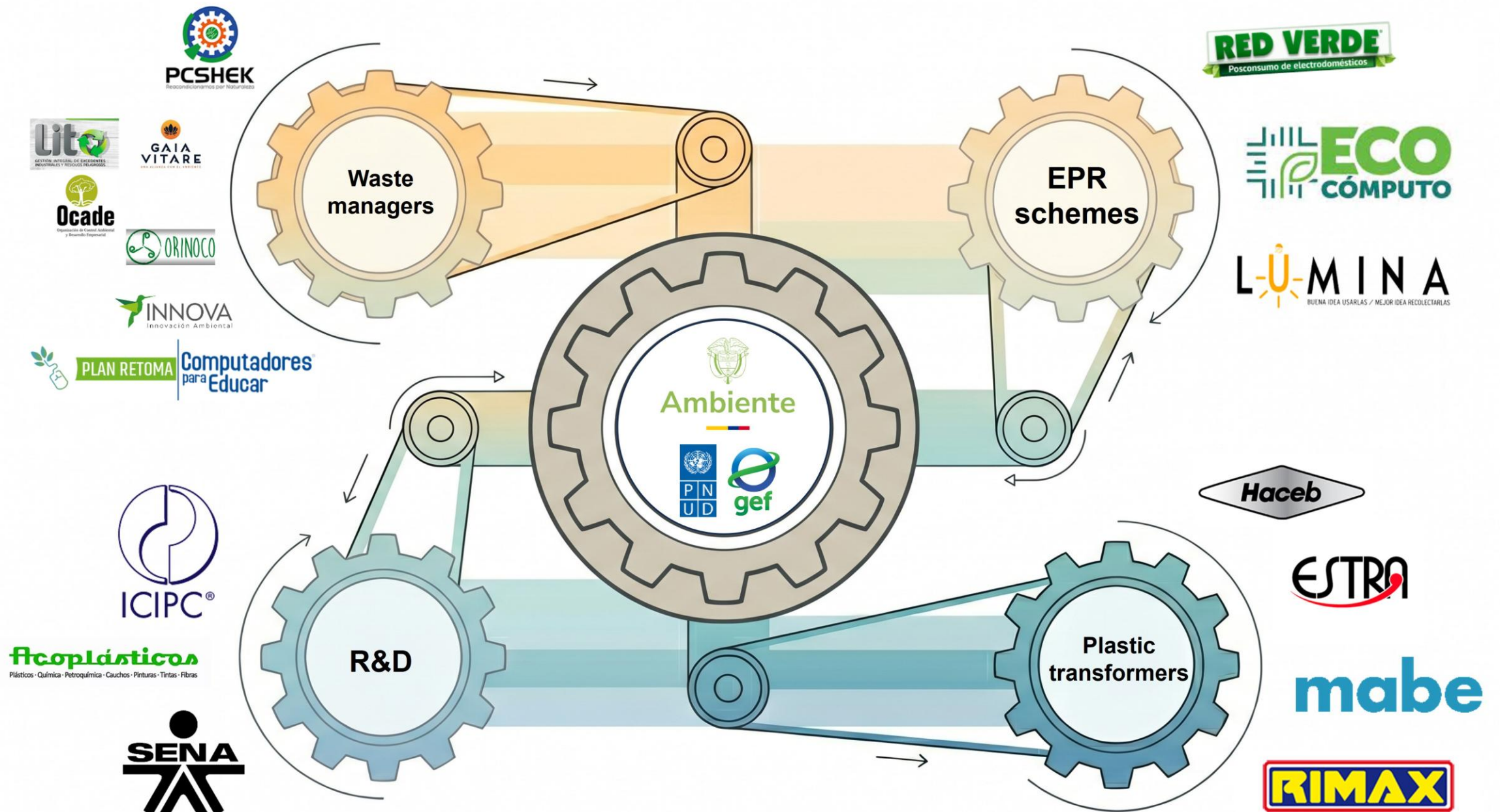


Ferrous metals
Steel scrap



Mixed materials & waste
Mixed plastics, glass, fines,
hazardous waste





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



Directrices técnicas

PARA EL MANEJO DE MATERIALES
PLÁSTICOS RECUPERADOS DE RAEE
Y VEHÍCULOS DESINTEGRADOS



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

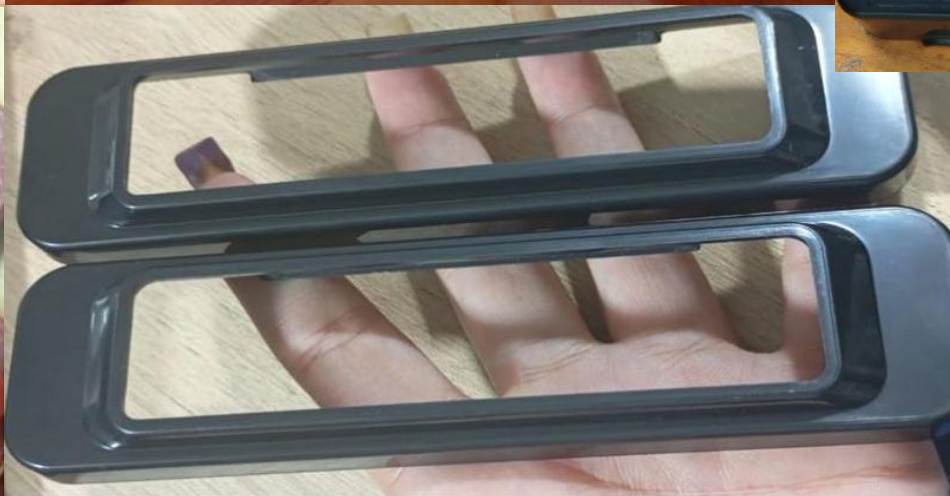
Use: Injection-molded plastic pallets

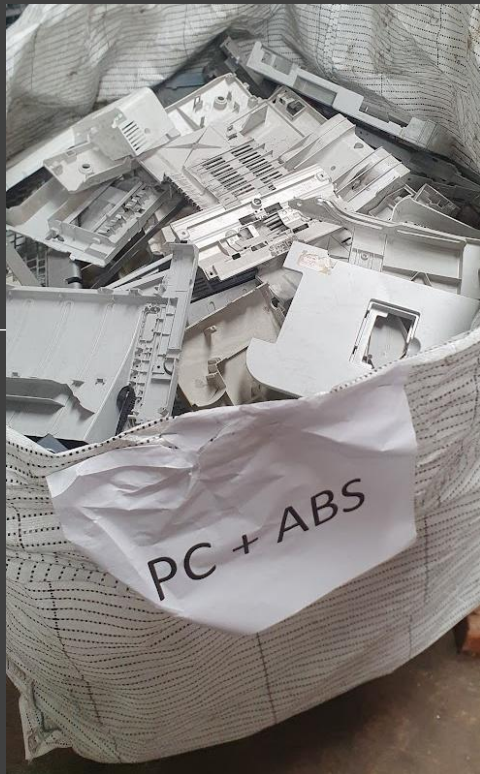
Dimensional test: passed

Functional test: passed

Appearance test: passed

Additional examples...





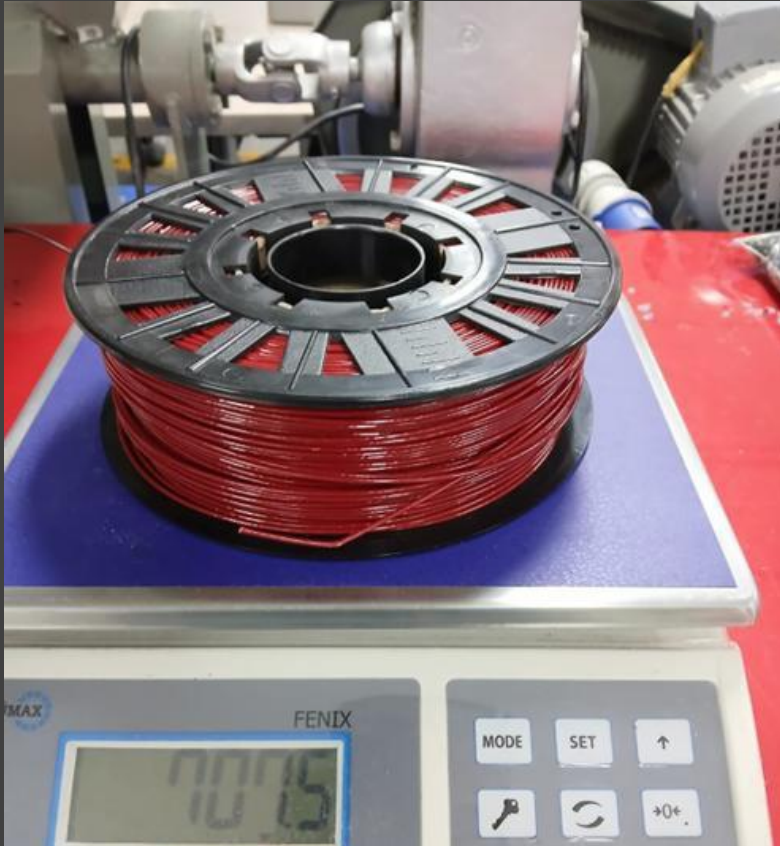
Estimated Price Recovered ABS
(USD/kg)

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**

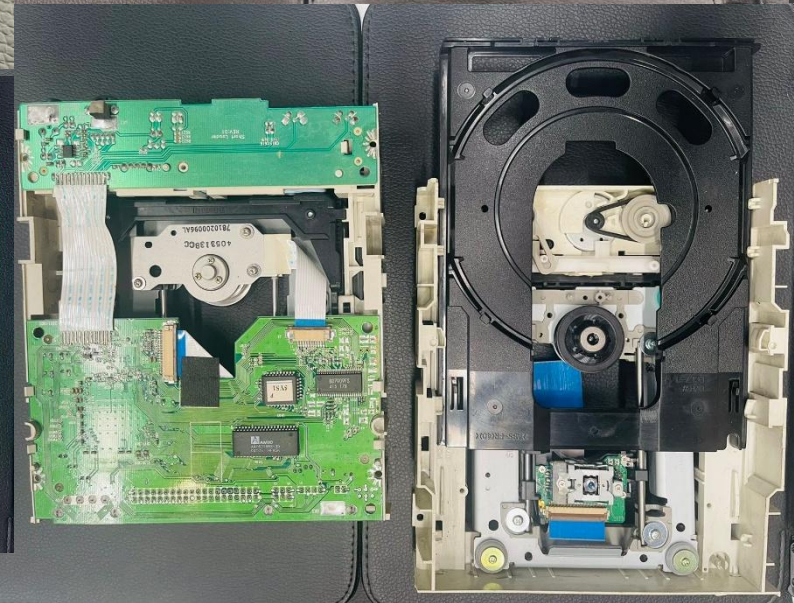
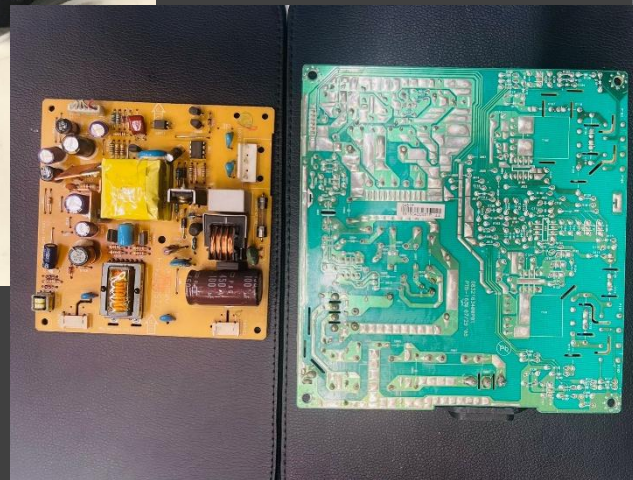
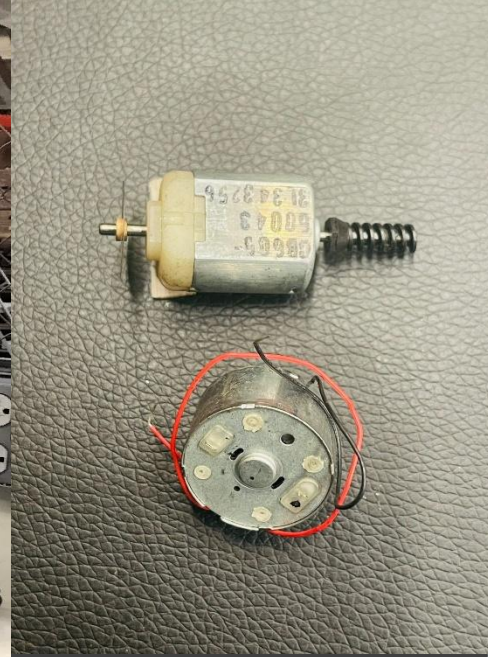
Functional test: **passed**



“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!

Edwin Camelo-Martínez
UNDP Colombia
edwin.camelo@undp.org
+57 3185216330

