LIFE PlasPLUS

Recycling of high-quality secondary thermoplastics and critical raw materials coming from WEEE and ELV

February 1rst, 2022

This project has received funding from the European Union's LIFE Programme for Environment and Resource Efficiency under grant agreement No. LIFE18 ENV/BE/000368.

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Comet Traitements

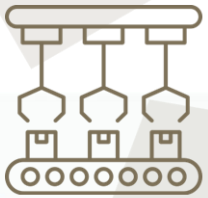
comet traitements

WELCOME

The **COMET Group** was born from a Belgian industrial company, family-owned, active in the **sector of ferrous and non-ferrous metals and their derivatives**.

Family group
Mainly active in **Belgium** and **France**

2 shredding sites :
- Chatelet
- Mons



8 PST plants for the recovery of secondary raw material out of both **shredder light and heavy fractions**

380 workers

R&D team :15 persons

- ✓ **1.200.000 tons of Metallic Wastes processed per year**
- ✓ **97,8% recycling rate**

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Metallic Wastes

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Metallic Wastes

Bulk Steel Scraps

But also :

		ELV	WEEE (cat. 2)
Ferrous	%	68,5	38
Non ferrous	%	8,5	28
Plastics	%	16,5	19
Glass	%	2,5	4
Wood	%	-	1
Fluids	%	2,0	-
Other	%	2,0	10
EU objectives	%	95 (2015)	50 to 90

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Metallic Wastes Recycling

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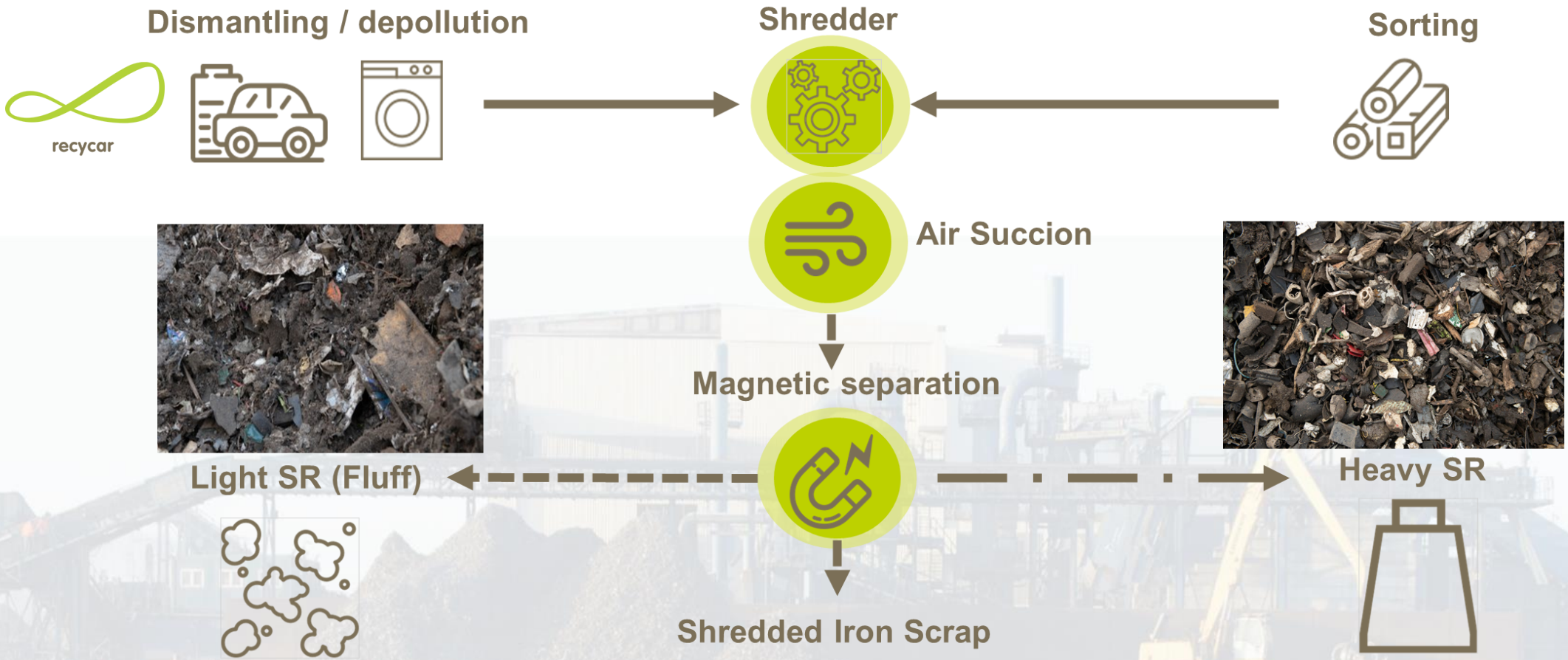

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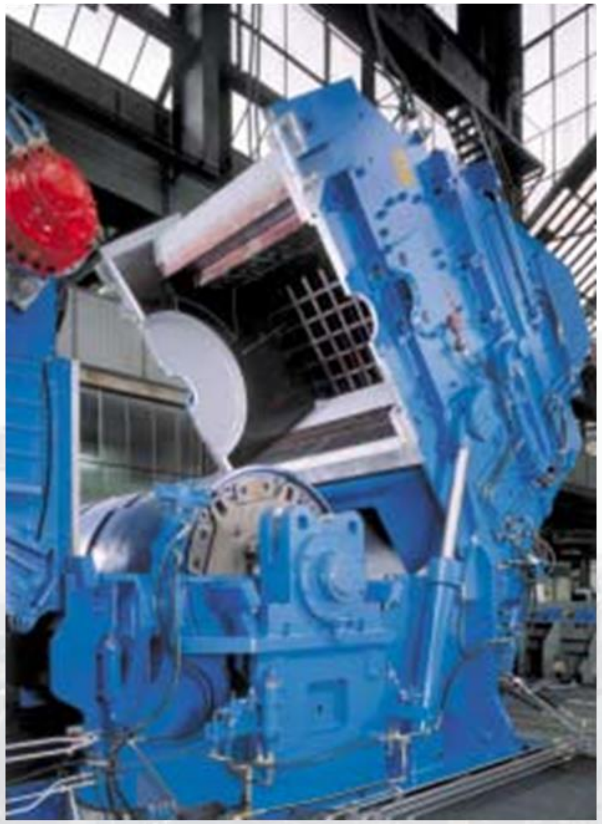
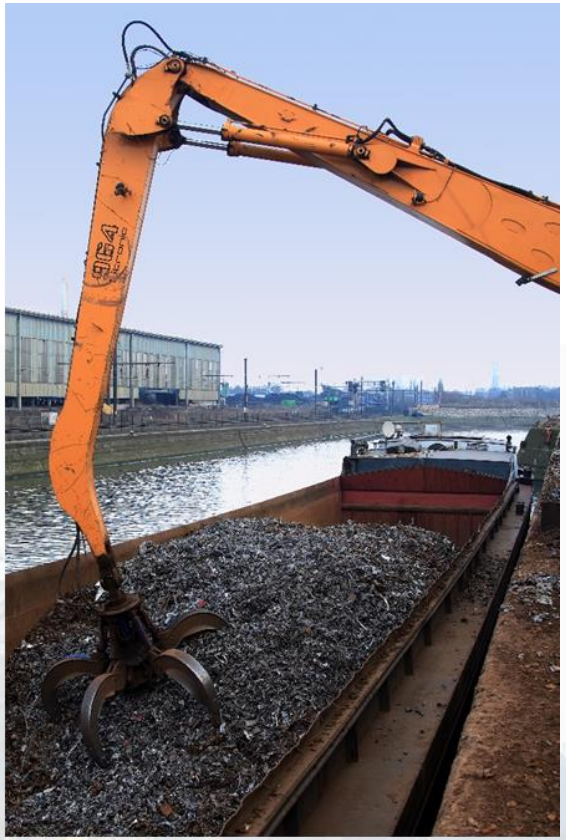
Metallic Wastes Recycling : shredding / magnetic separation





→ A mine of iron

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Metallic Wastes Recycling : the Shredder Residues

Shredder residues : a mine of secondary ores

Input 100%

Shredder → 77 % ferrous

Heavy Shredder Residues

Homogenous mix of non ferrous metals, rubber, plastics, inerts, etc.

Light Shredder Residues

Heterogeneous mix of textiles, plastics, foam, wood and fines particles

Mainly landfilled until the 90's

Recovery rate : > 95 %

Since 2000, **COMET Traitements** has developed unique expertise in the recycling of shredder residues through **various R&D programmes.**

Europe : 10 Mt per year of renewable ores

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Shredder Residues Recovery

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Plastics

Regrinds for compounds to EEA, Automotive, Water treatment parts,…

Wood, foam

Alternative Fuels, Energy, Char

Iron Oxides

Iron ore for cement industry

Glass

Bituminous concrete for motorway

Non-ferrous metals

Robotic Sorting in pure Fractions

97,8%

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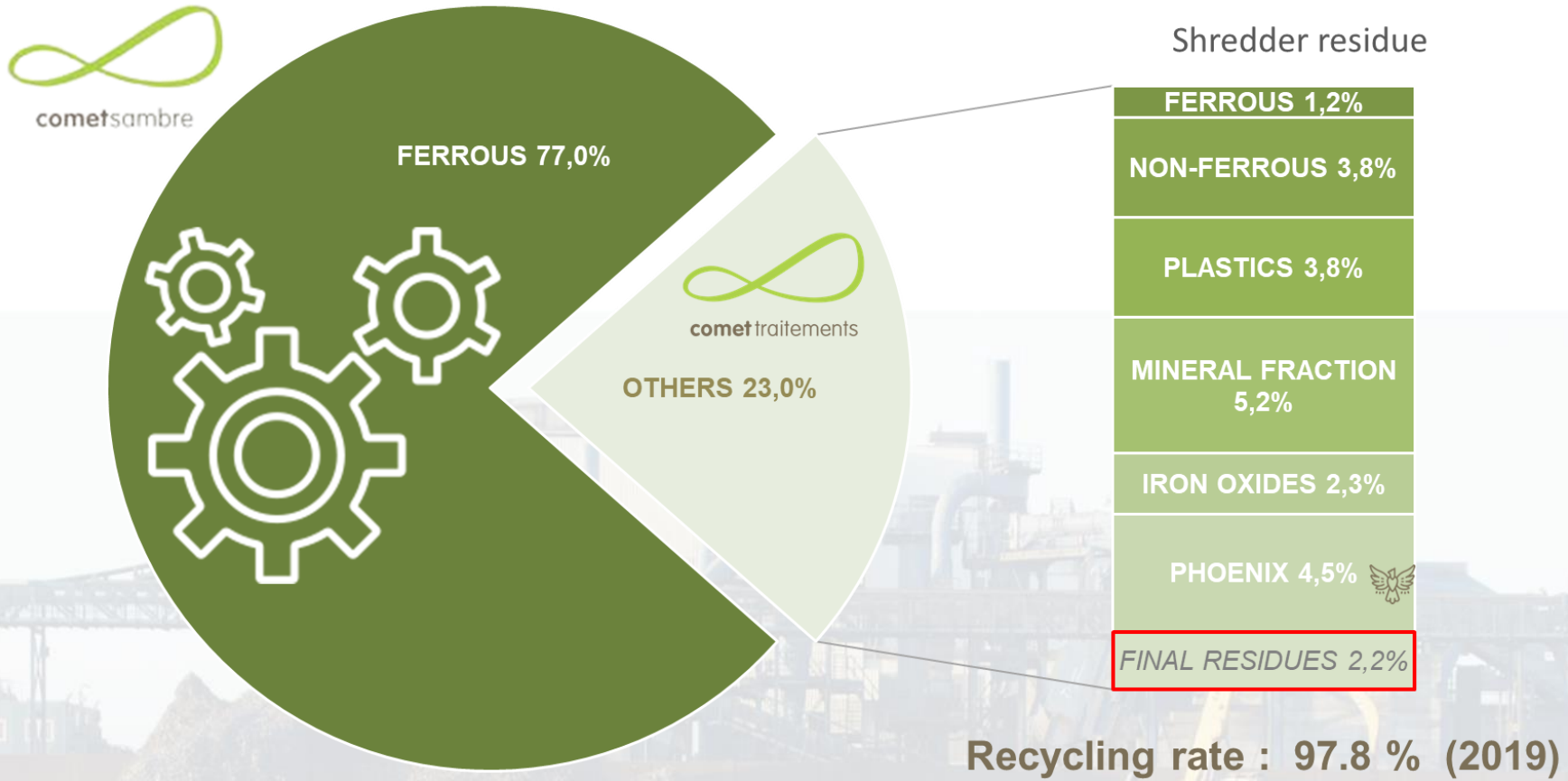
Comet Traitements

Shredder Residues Recovery



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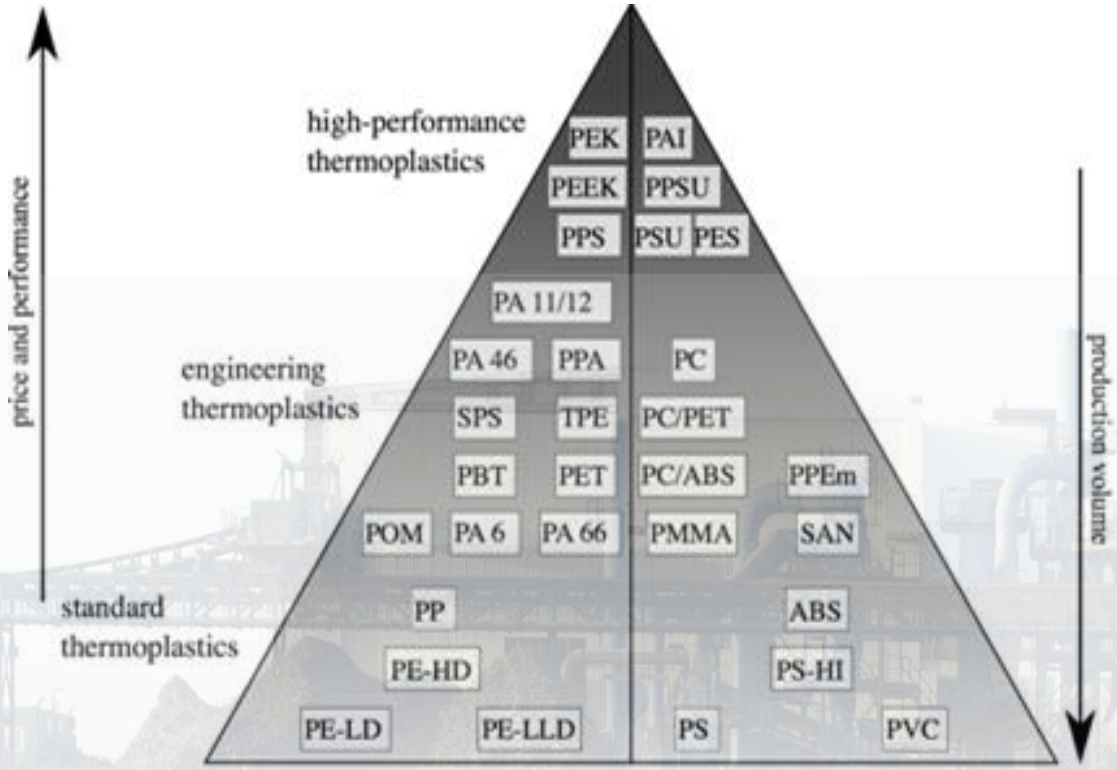
Shredder Residues Recovery : « Plastics »



All types of plastics are present in the Shredder Residues

+ rubber, elastomers, silicones, wood, etc,

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Shredder Residues Recovery : « Plastics »

Plastic PST plant : capacity 85,000 t/y of Mixes SR Plastic Stream - since 2012

From heterogeneous mixes…

…to purified PP/PE/ABS/PS fractions

R&D goal : closing the loop with Circular Plastics

= => Ongoing R&D projects to use these plastics in its their own manufacturing process

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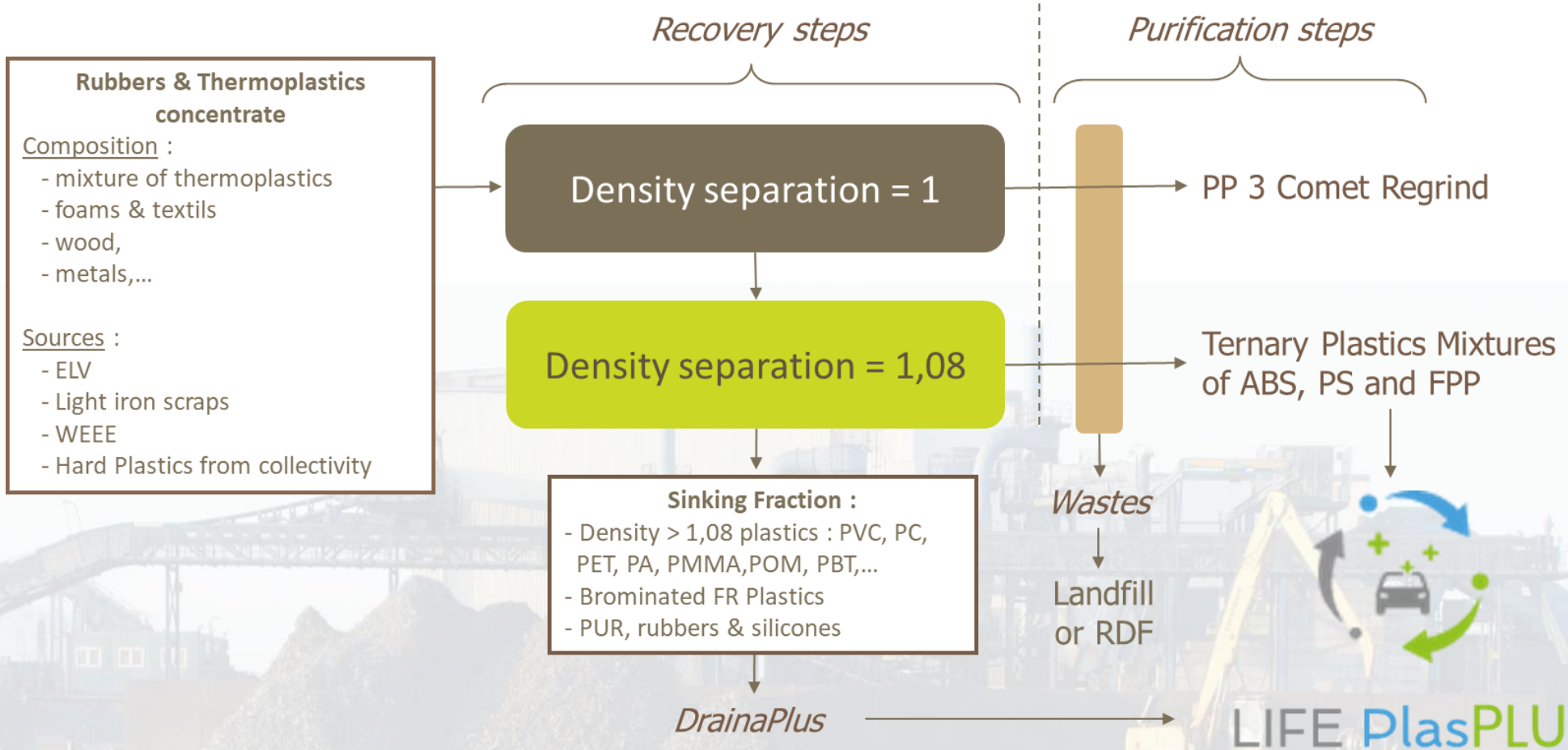
Shredder Residues Recovery : « Plastics »



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Project Overview

Project Location : Obourg, Walloon Region, Belgium

Project Budget : Total amount: 3,170,420 Euro
% EC Co-funding: 1,430,450 Euro
(45% of the total budget)

Duration : 01/07/2019 - 31/12/2022

Coordinating Beneficiary : comet traitements

Associated Beneficiaries : LIÈGE université, STELLANTIS, CRF, Campine, SERIPLAST POLYPROPYLENE COMPOUNDS

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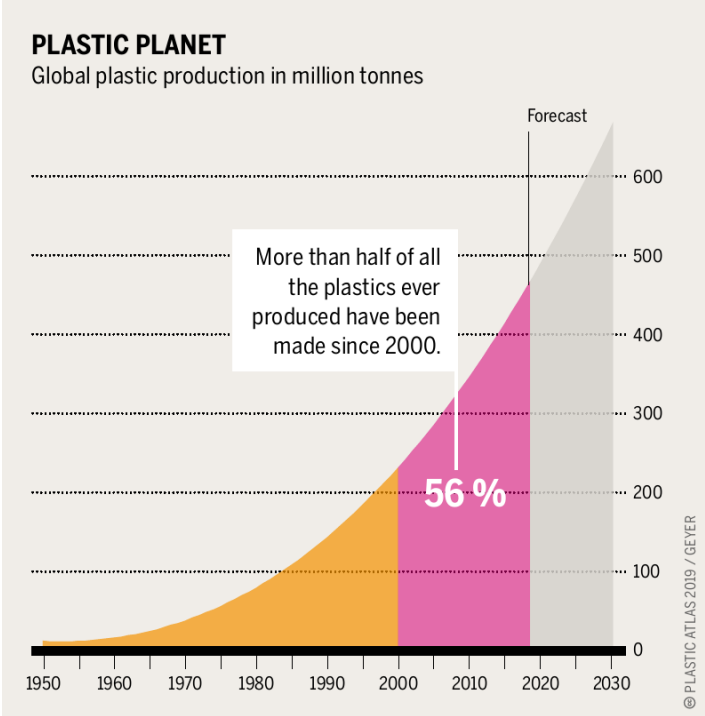
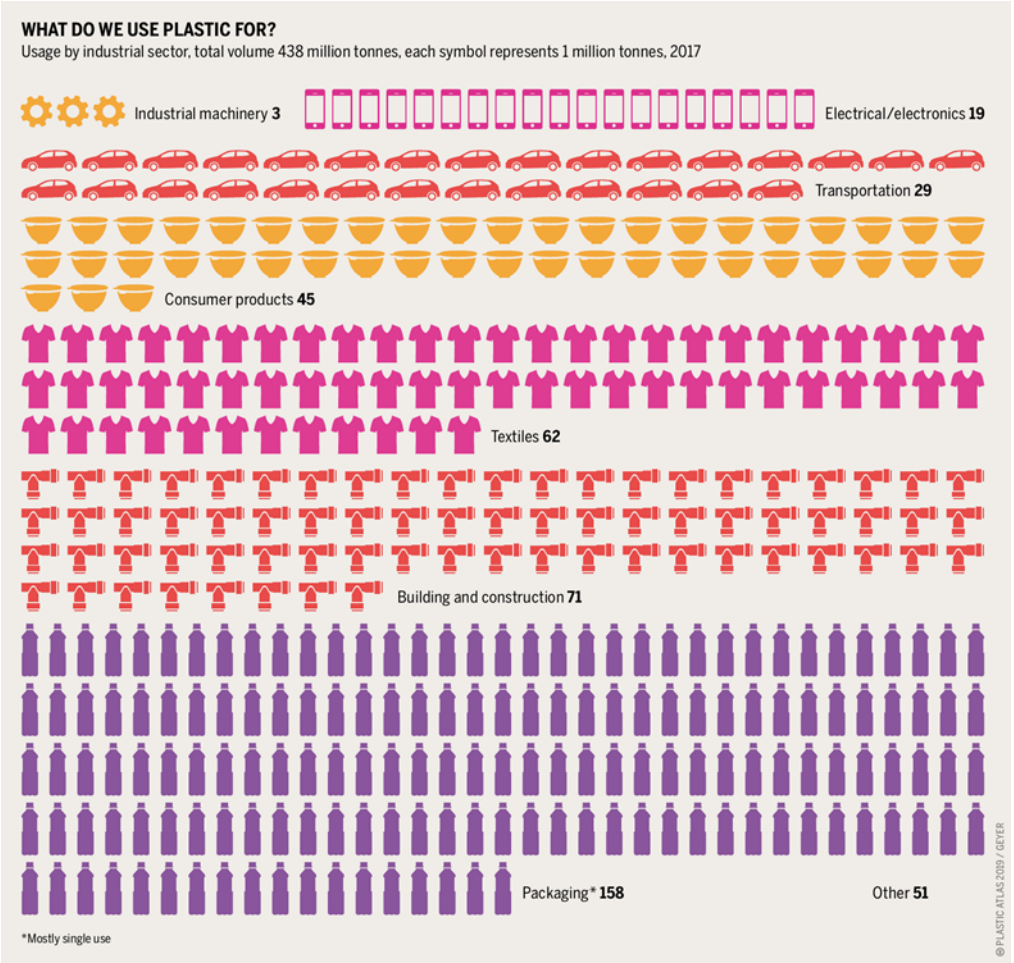
Plastic Metrics

- **9 billion tons of plastic have been produced since the 1950s.**
- **Only 9% of plastic waste ever produced ended up recycled.**
- **438 million tons of plastics were produced in 2017.**
- **EEE and transportation usages accounted for 19 and 29 M tons respectively (or 4.3% and 6.6%).***





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*PLASTIC ATLAS | Appenzeller/Hecher/Sack CC-BY-4.0

LIFE PlasPLUS : EoL Waste Streams

WEEE :
19M tons over total production of 438M tons in 2017 (4,3%).

ELV:
29M tons over total production of 438M tons in 2017 (6,6%).

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LIFE PlasPLUS : Innovation and Added Value

LIFE PlasPLUS revisits the concept of recycling with its holistic approach to simultaneously close the loop for two traditionally siloed material value chains, ***plastics*** and ***minerals***, by producing :

high purity recycled **thermoplastics** and **antimony**,

… two materials in high demand, notably for the emerging electric mobility sector requiring the increased use of lightweight materials and flame retardants to, respectively, ***lower energy consumption*** and ***increased fire safety***.

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LIFE PlasPLUS : Partners and Material Value Chain

COMET TRAITEMENTS

UNIVERSITY OF LIEGE

CAMPINE

SERIPLAST

STELLANTIS (CRF)

Waste sorting and valorization	Research and development	Production of antimony	Plastic compounding	Car manufacturing

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LIFE PlasPLUS : Objectives

- **Demonstrate the feasibility of recycling 45% of the plastic concentrate** into added-value thermoplastic streams by scaling up a new froth flotation/triboelectricity demonstration unit.
- **Achieve a scale up of the current to pre-commercial level of continuous production at 1 500 kg/h at TRL7**. This will process >98%-pure polystyrene (PP), filled polypropylene (FPP) and acrylonitrile butadiene styrene (ABS) regrinds.
- **Adapt a sensor-enabled separator that can detect flame retardant plastics (FRPs)** and separate fibre-reinforced plastic at 250 kg/h.
- **Showcase a closed-loop production for the valuable flame-retardant element** (Antimony Trioxide -ATO- or Sb2O3), also validating its flame-retardant performance in recycled plastics.
- **Substitute >40% virgin plastics with secondary ones** in three new secondary compounds for the automotive and EEE markets.
- **Validate the quality of the produced compounds** in three standard vehicle parts and in flame retardant batches for the EEE sector.
- **Conduct life cycle analyses and socio-economic analyses** to confirm the environmental benefits and techno-economic soundness of the concept.
- **Develop a replication and transfer plan as a sustainable business** model for other facilities around Europe.

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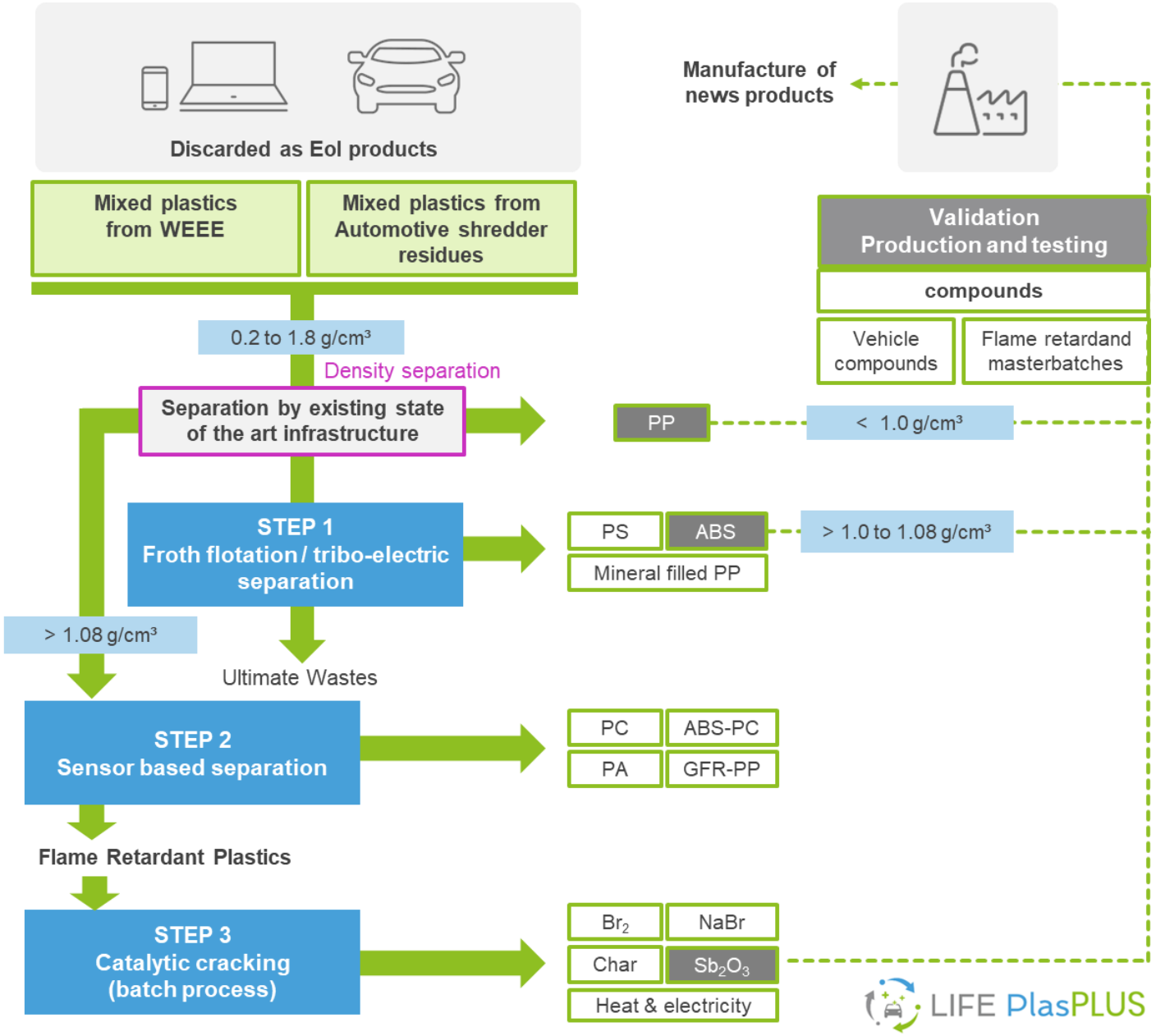
Steps and Flowsheet

Step 1 :
Production of high purity regrinds thermoplastics

Step 2 :
Sorting and separation of Flame Retardant Plastics (FRP) to prevent landfilling

Step 3 :
- Catalytic cracking of FRP
- Recycling of by-product antimony

Validation, Production & Testing



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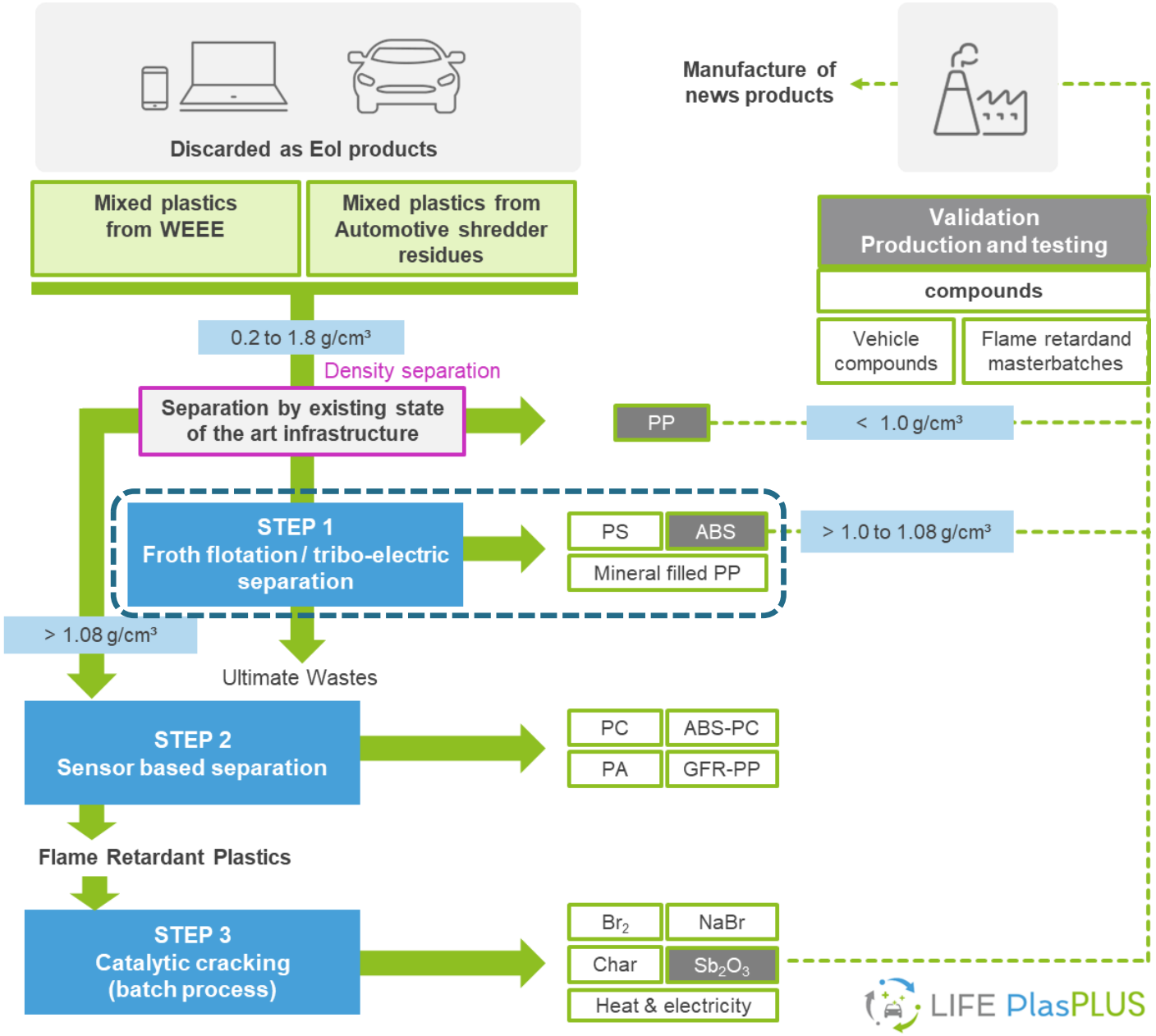

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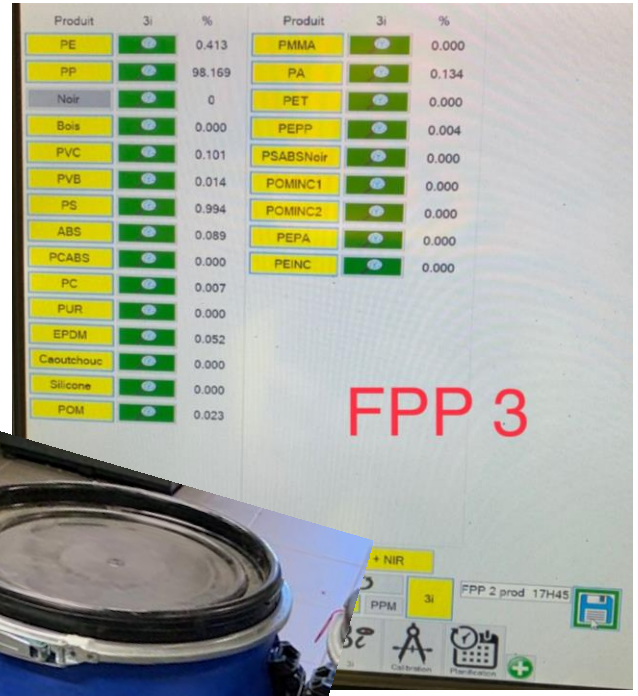
Project progress

Step 1: Production of high purity thermoplastics : ABS & FPP

Ternary Plastic Mixture Demonstration Unit : on production to demonstrate on large quantities of PS, ABS and FPP



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Project progress

Step 1: Production of high purity thermoplastics : ABS & FPP

FPP Comet Regrind

~ 35 kg delivered to SERIPLAST

ABS Comet Regrind

~ 37 kg delivered to SERIPLAST

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Project progress

Step 1: Production of high purity thermoplastics : ABS & FPP

Qualities

	Average composition		
Purified Fraction	ABS (%)	PS (%)	F PP (%)
F PP Comet Regring	0,05	0,69	98,66
ABS Comet Regrind	98,05	1,36	0,15

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Project progress

Step 1: Production of high purity thermoplastics : ABS & F PP

Heavy metals	Limit "RoHS 3" (ppm)	FPP (1 sample) ppm	ABS (1 sample) ppm	PS (3 samples) ppm
Cd	100	5,52	23,9	17,4 to 28,8
Pb	1000	27,2	7,93	32,5 to 62,8
Hg	1000	< 2	< 2	< 2
Cr (VI)	1000	< 8	< 8	< 8
Brominated Flame Retardant	**Limit "RoHS 3" (ppm)**	**ppm**	**ppm**	**ppm**
Sum of PBBs	1000	<5	< 5	<5
Sum PBDEs	1000	27,8	< 5	56,77 to 224,51
Details of PBDEs :				
Octabromodiphényl ether		*< 5*	*< 5*	*6,11*
Nonabromodiphényl ether		*< 5*	*< 5*	*8,67 to 25,4*
Décabromodiphényl ether		*27,8*	*< 5*	*48,1 to 193*

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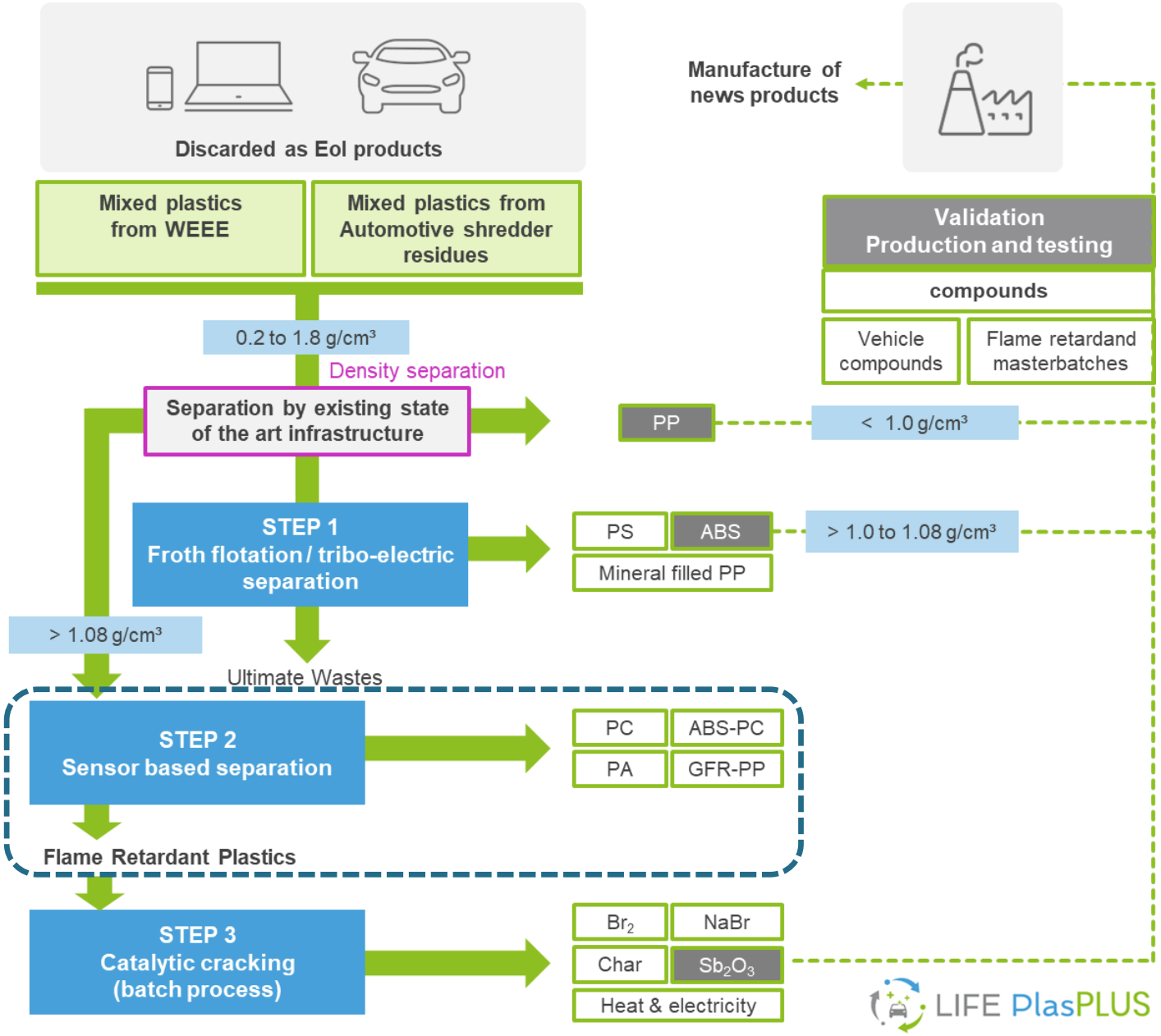

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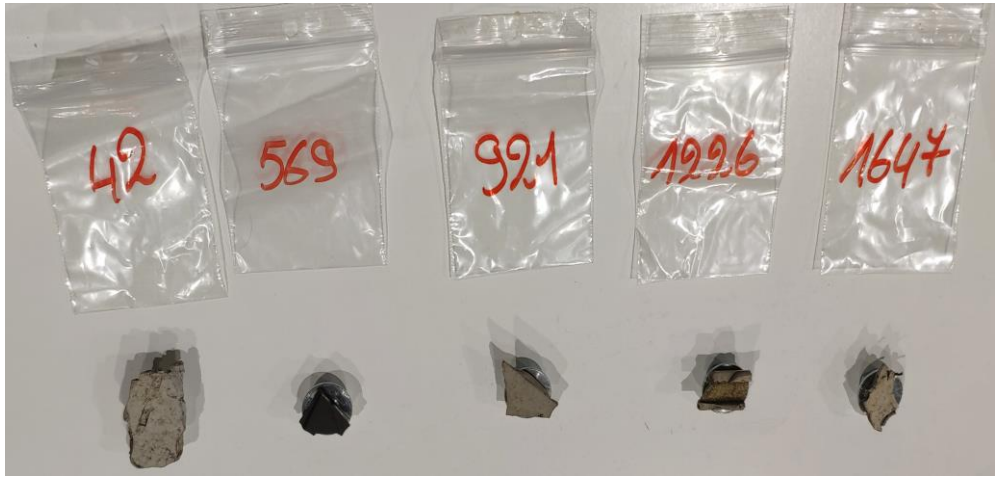
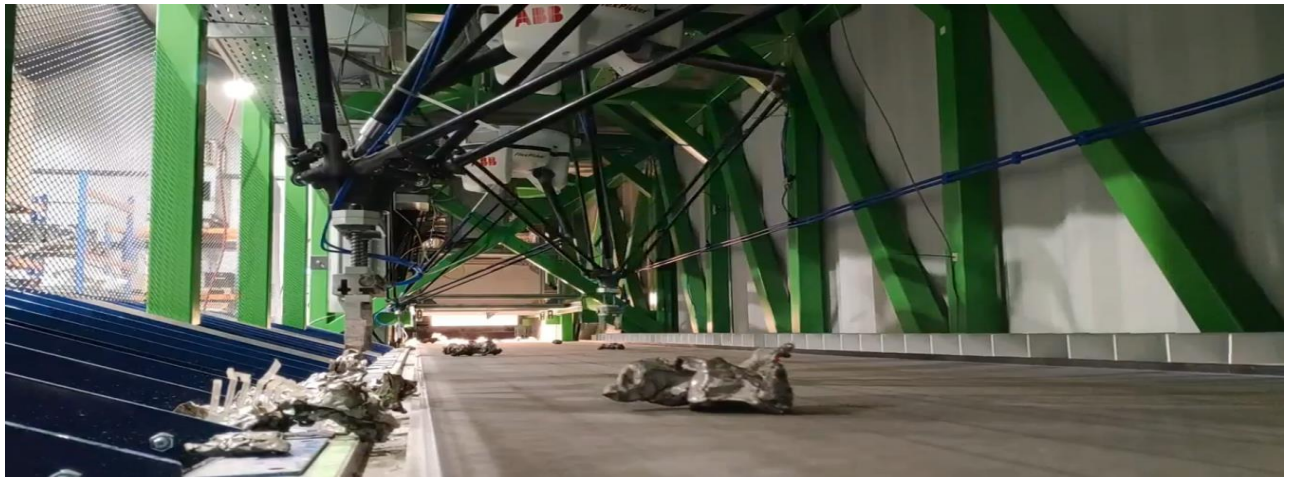
Project progress

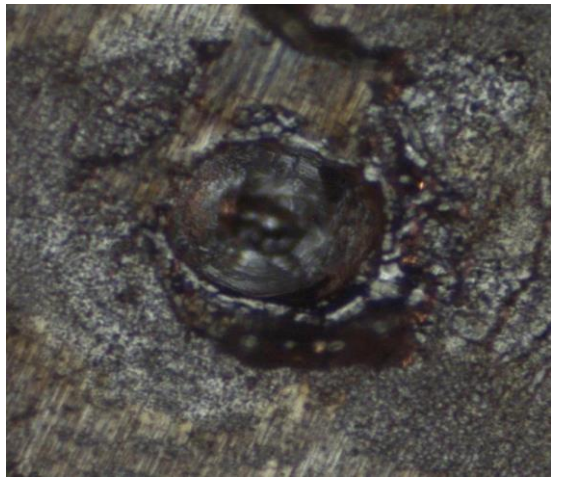
Step 2: Automated multi-class sensor-based sorting and separation of Flame Retardant Plastic

PICKIT

a) Adapting the LIBS setup for the PICKIT prototype
b) Data Acquisition
c) Signal Processing
d) Characterization with XRF portable analyzer
e) Benchmarking of Redwave XRF sorting technology







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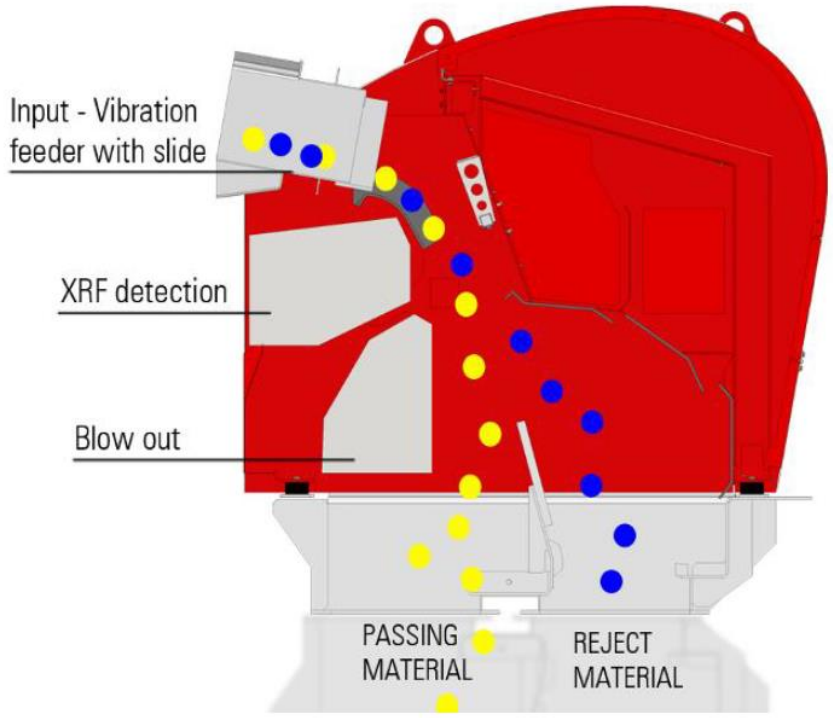
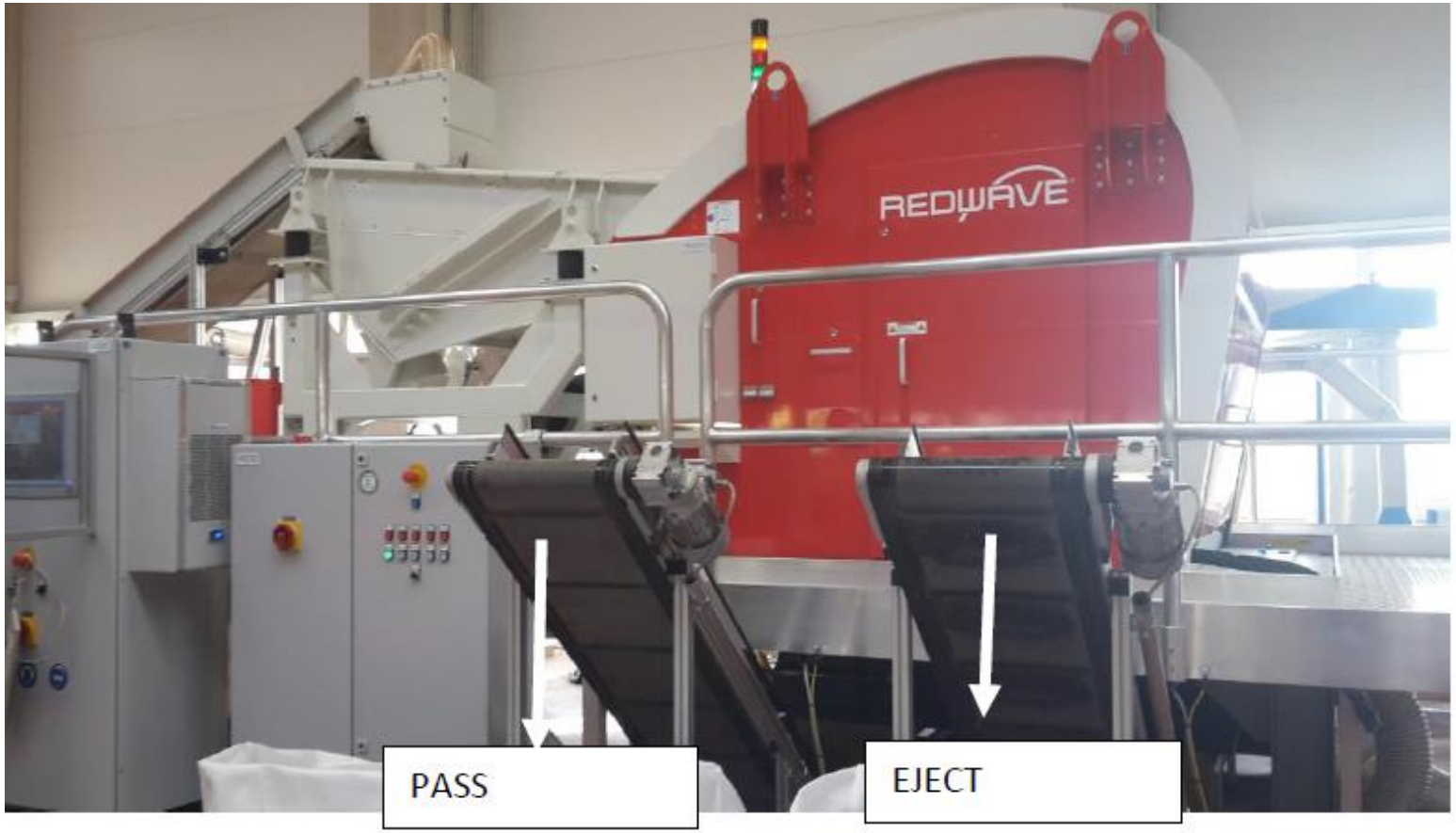
REDWAVE XRF

Equipment supplier sorting unit





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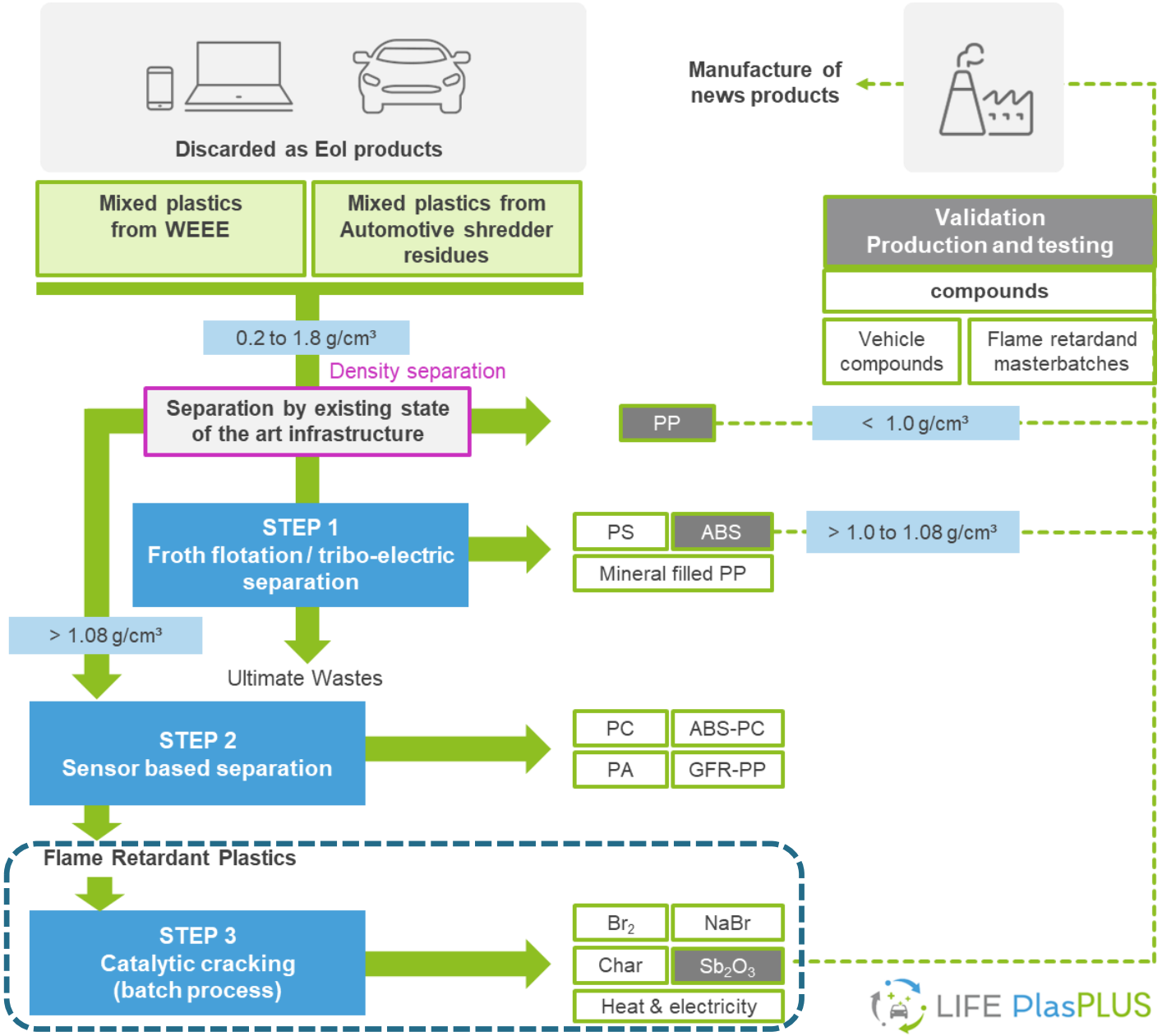

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Project progress

Step 3: Recycling of by-product antimony (Sb) through catalytic conversion and hydrometallurgy

PYROLYSIS Pilot TESTING

Comet Traitements characterized and performed the catalytic conversion of the first batch of FRP which delivered 300 kg of Sb bearing Char at a grade of 4% Sb for an approximate equivalent of 12 kg of Sb metal contained.

Antimony (Sb) and Bromine (Br) contents of input Flame Retardant Plastics (FRP)

- Br in FRP: 18.200 ppm
- Sb in FRP: 9.100 ppm

Pyrolysis of Flame Retardant Plastics (FRP)

- Sb → Mostly in char: char (94%), liquid HC (6%)
- Sb → 3% of Sb in char is released into water after quenching
- Quench: char put in boiling distillated water for 2 hours

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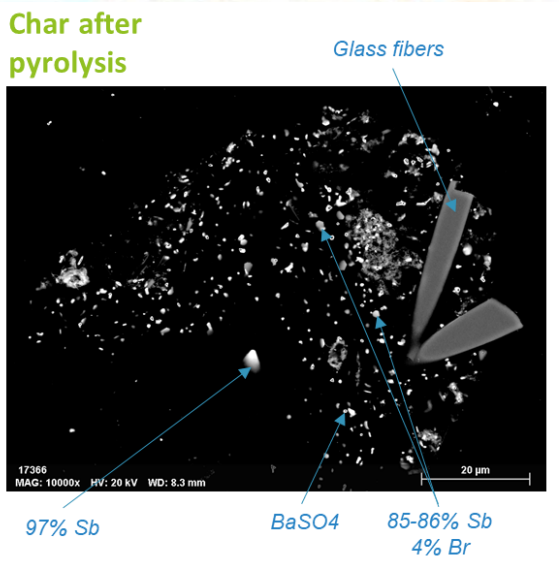
Project progress

Step 3: Recycling of by-product antimony (Sb) through catalytic conversion and hydrometallurgy

Sb Char TESTING

Université de Liège characterized the char coming from the lab test pyrolysis of FRP through SEM analysis and identified an **oxidative hydrometallurgical route** to produce the Antimony Trioxide for Campine.

In parallel, Campine suggested and will study a **direct Sb injection route for the Sb-Char which could be used "as-is" for its reducing chemical properties**.



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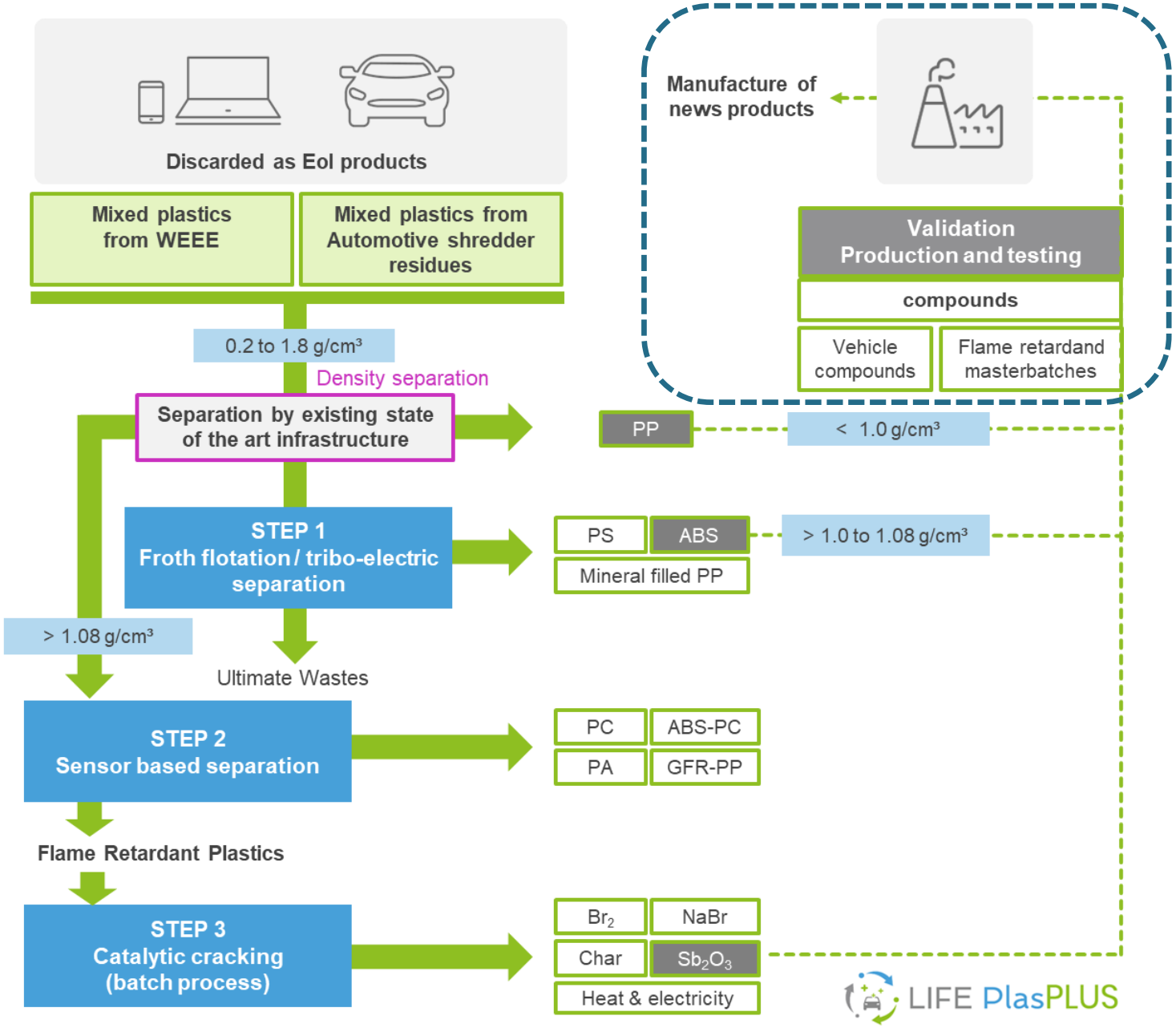

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LIFE PlasPLUS

Project progress

Validation, Production & Testing

FPP Compounds formulation & validation

R-PP compounds: AUTOMOTIVE sector

COMPLIANCE OF FCA REQUIREMENT

Properties	ISO	UM	PP 60.35	FPP COMPOUND
MFI	ISO1133	g/10min	15-25	8
Ash Content	ISO3451	%	18-27	26
Density	ISO1183	g/cm³	1.05-1.10	1,09
IZOD	ISO 180	kJ/m²	3.5	5,7
Flexural Modulus	ISO 178	MPa	2200	2240
Tensile Strength (elongation at break)	ISO 527	%	20	12
Tensile Strength (max load)	ISO 527	MPa	23	24
VICAT	ISO 306	°C	64	69

✓ 70 % RECYLED PP (FPP)

Properties	ISO	UM	PP 65.40	FPP COMPOUND
MFI	ISO1133	g/10min	4-10	6
Ash Content	ISO3451	%	23-32	23
Density	ISO1183	g/cm³	1.11-1,17	1,07
IZOD	ISO 180	kJ/m²	4-7	6
Flexural Modulus	ISO 178	MPa	2500	2310
Tensile Strength (elongation at break)	ISO 527	%	15	15
Tensile Strength (max load)	ISO 527	MPa	20	22,1
VICAT	ISO 306	°C	67	68,2

✓ 50 % RECYLED PP (FPP)

R-PP compounds: EEE sector

PROPERTIES	U.M	ISO	EEE SPECIFICATION	FINAL RESULTS
MFI	g/10'	1133	12-20	13,7
DENSITÀ	g/cm³	1183	1,05-1,13	1,08
FLEXURAL MODULUS	Mpa	178	2000-2500	2300
TENSILE STRESS (AT YIELD)	Mpa	527	40	30-33
IZOD	kJ/m²	180	4,5-6	5,3
H.D.T. (0,45 Mpa)	°c	75	90/95	90

SMALL HOME ELECTRONIC APPLIANCE AND ELECTRONIC DEVICE

✓ 100 % RECYLED PP (FPP)

All FPP Compounds with a virgin plastics substitution over 40%

ABS Compounds coming soon

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Project progress

Validation, Production & Testing

Compounds production to validate in Automotive Parts

Coming soon in 2022

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LIFE PlasPLUS

Policy Implications

- **ELV Directive (2000/53/EC)**

  The project addresses the recycling and reuse of ELV components.

- **Landfill Directive (EU 2018/850)**

  The project aims at diverting a wider proportion of ELV and WEEE plastics from landfill.

- **European Strategy for Plastics in a Circular Economy (COM/2018/028 final)**

  The project prevents the downcycling of high-quality secondary thermoplastics waste from ELVs and WEEE, an underexploited reserve of valuable plastic fractions.

- **The WEEE Directive ((EU) 2012/19)**

  The project tackles the problem of FRPs in the WEEE recycling stream, by enabling these components to be identified from the sinking plastic fraction in an automated and rigorous manner.

- **EU Raw Materials Initiative (COM/2008/0699 final)**

  The project demonstrates a recycling route for Sb, a Critical Raw Material with a very high supply-risk.

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LIFE PlasPLUS

Thank you

SEE YOU NEXT AT OUR
SECOND DEDICATED EVENT !

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