

W2Plastics: The mixed plastics waste recycling technology

Resources & Recycling group



➤ W2Plastics principles

➤ W2Plastics production video

➤ W2Plastics products tests

➤ W2Plastics business cases

Background

Current recycling methods

- Sources of polyolefins
 - Gray bags (incinerated)
 - Separately collected (recycled)
- Sorting methods for polyolefins
 - NIR (Near Infrared)
 - Needs large pieces (e.g. bottles)
 - 95-97% product quality
 - Low recovery (60%)
 - Ordinary sink-float
 - Density separation (flake)
 - Expensive
 - Complex process
 - Limited separation flexibility



W2Plastics principles

Particle is at equilibrium if it has the same weight as the volume of replaced ferrofluid



← ● Light polymer

← ● Heavier polymer

← ● Heaviest polymer

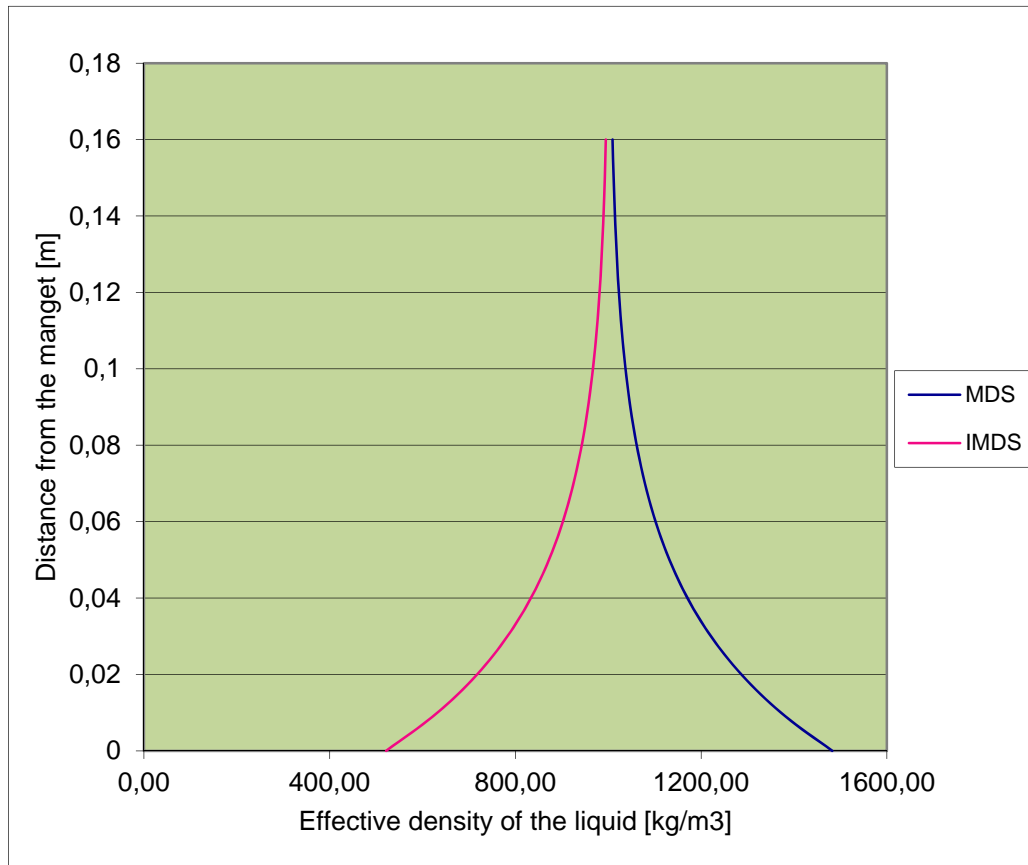
↑ Ferrofluid weighs **less** (increasing magnetic attraction)

↓ Ferrofluid weighs **more**



Magnet

W2Plastics principles

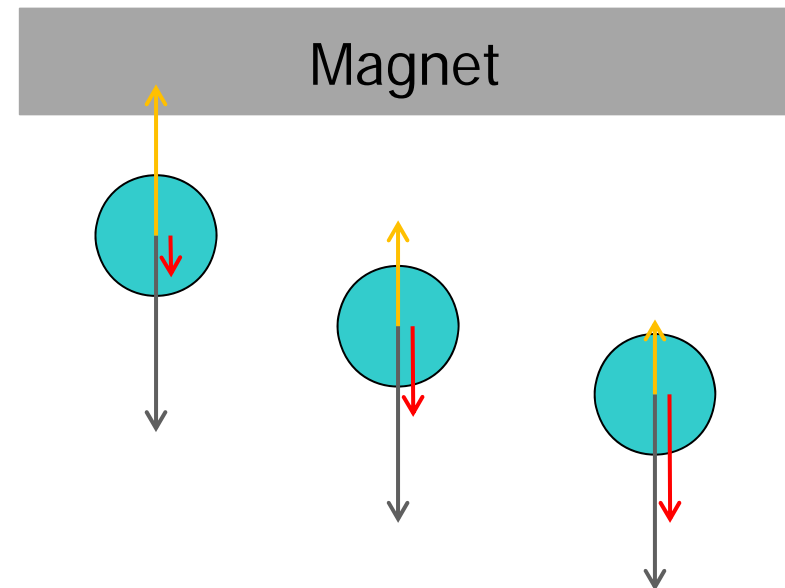


Equilibrium height above magnet for various plastics

Particle floats in a liquid if it has the same weight as the volume of replaced liquid

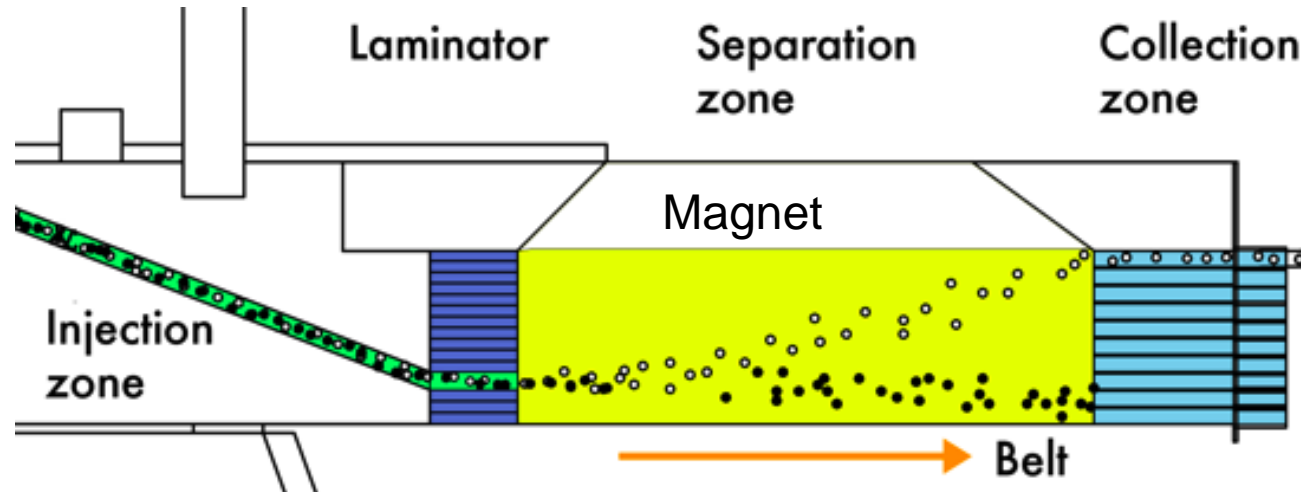
W2Plastics principles

Magnetic liquid is attracted both by the earth and by magnets: variable weight!



- Magnetic liquid
- > Attraction
- > Gravity
- > Weight

W2Plastics principles



- Magfluids have no densities limits
- Magfluids have different densities at different positions: multiple products
- Magfluids for plastics separation can be used as ordinary water

Industrial MDS



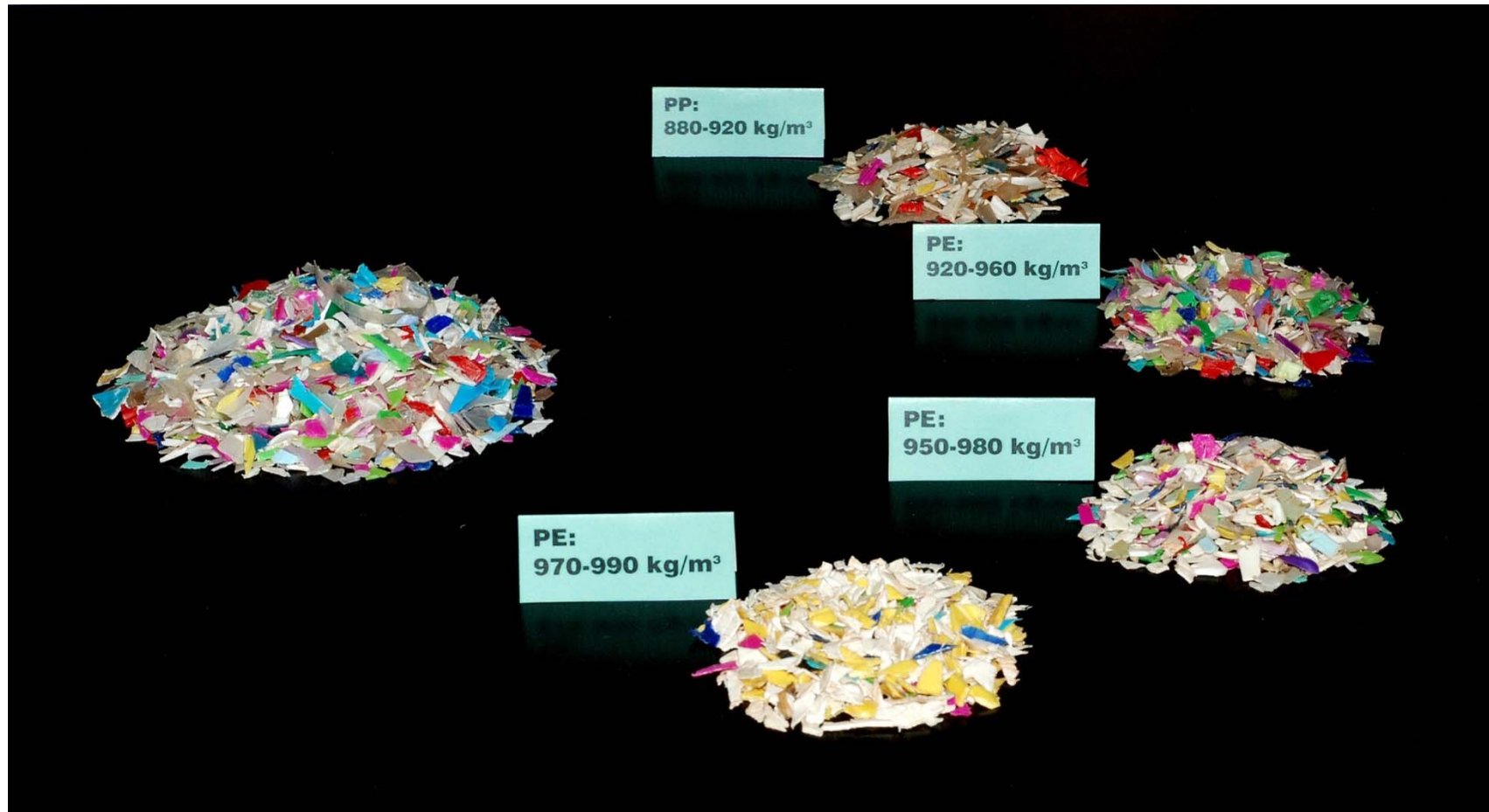
Industrial MDS



Industrial MDS

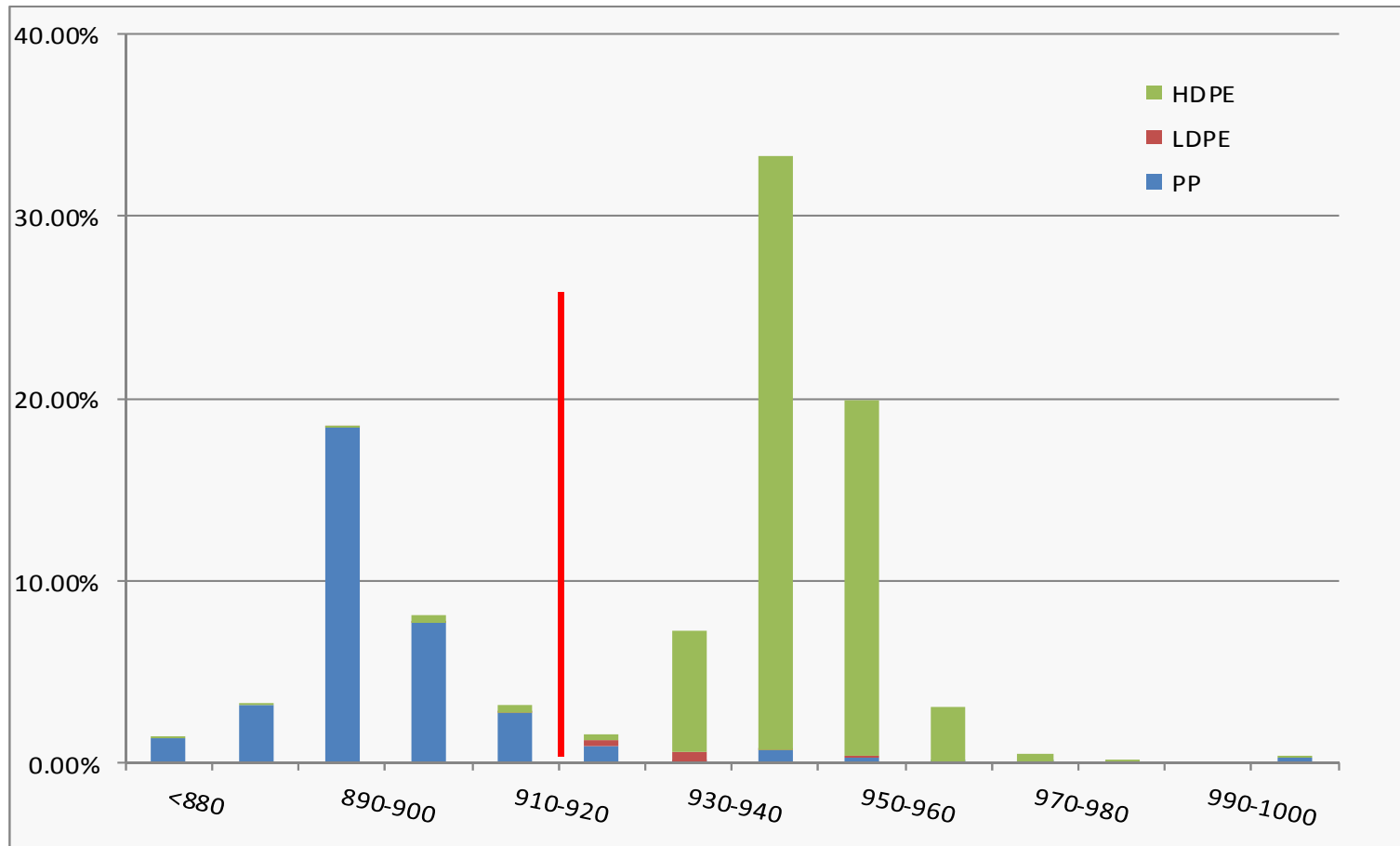


W2Plastics products tests



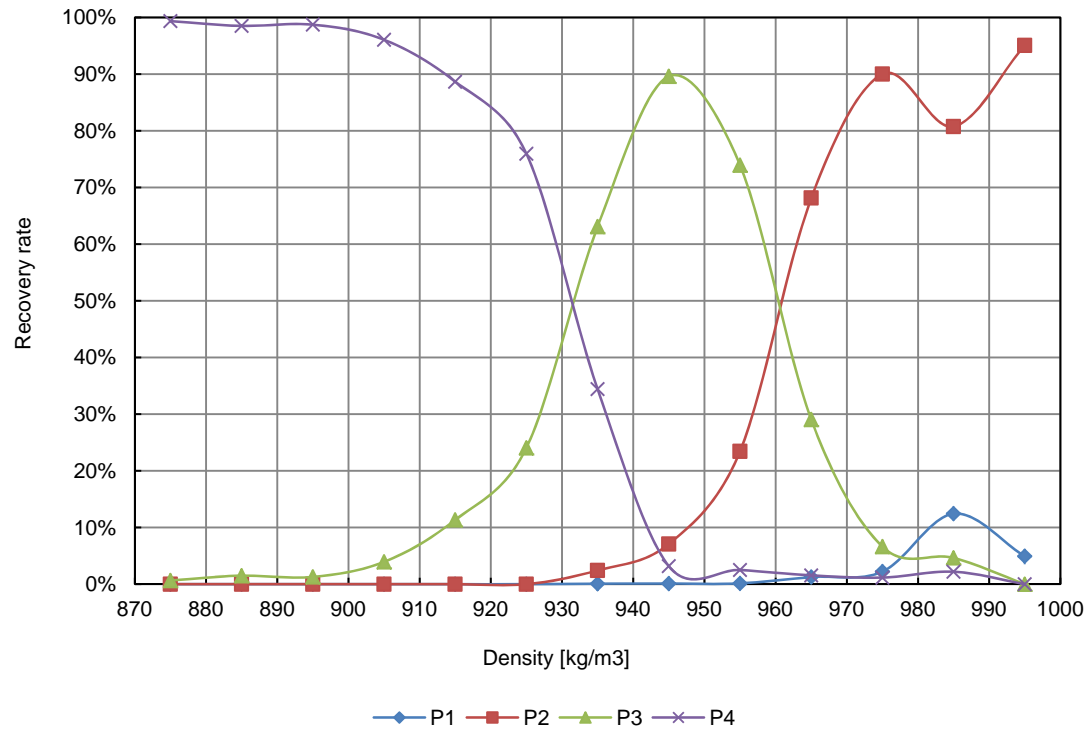
W2Plastics products tests

Density distribution of Romanian households waste



W2Plastics products tests

Romanian Household Waste

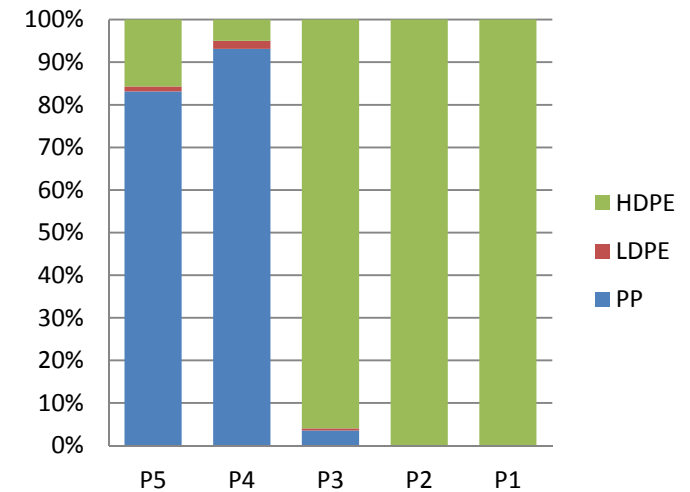


$E_p = 5-6 \text{ kg/m}^3$

Recovery for PP and PE: 93%, 96%

Four products in one go

RO HHW GRADE



P5: residue

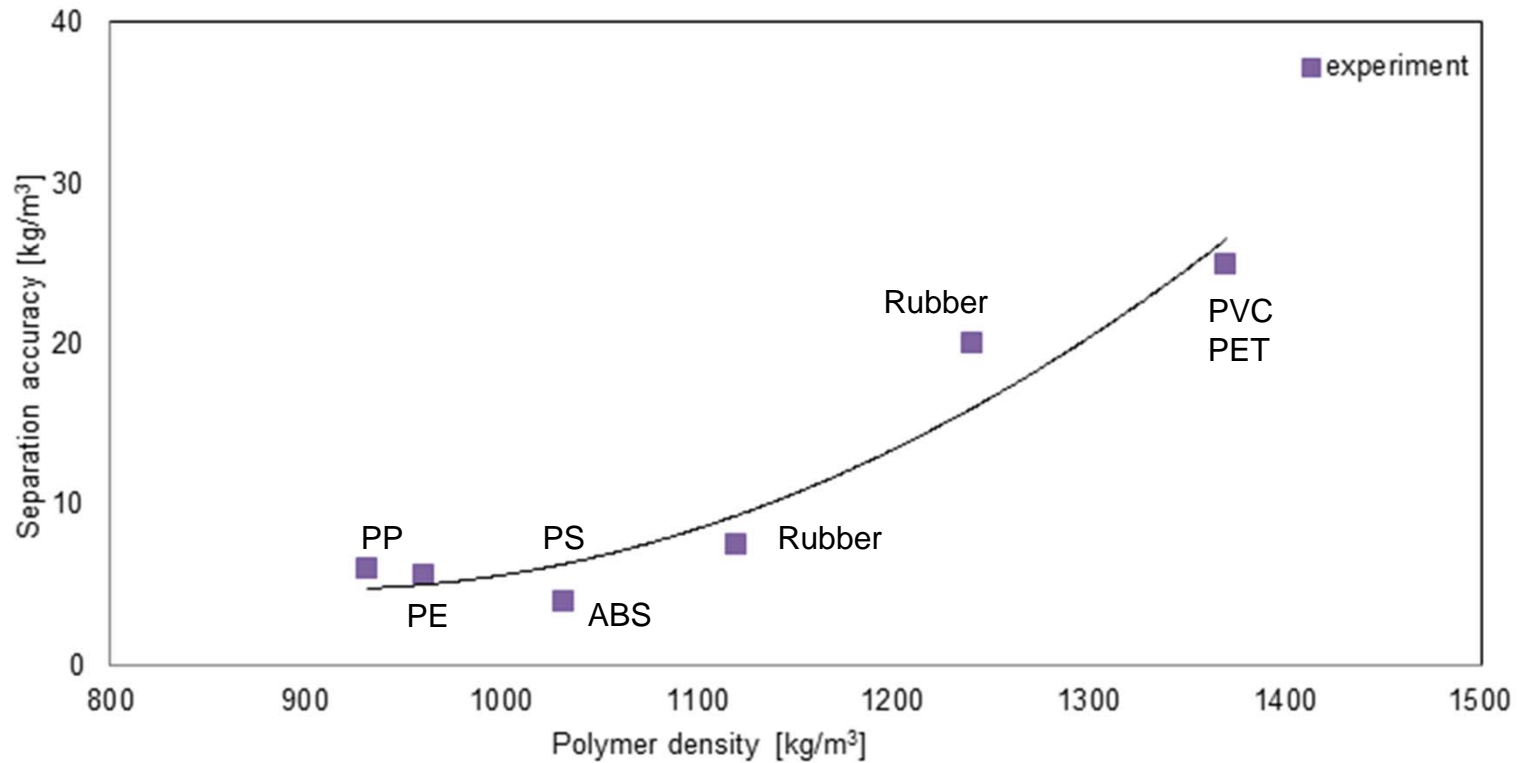
P4 (PP): 93%

P3 (PE): 96%

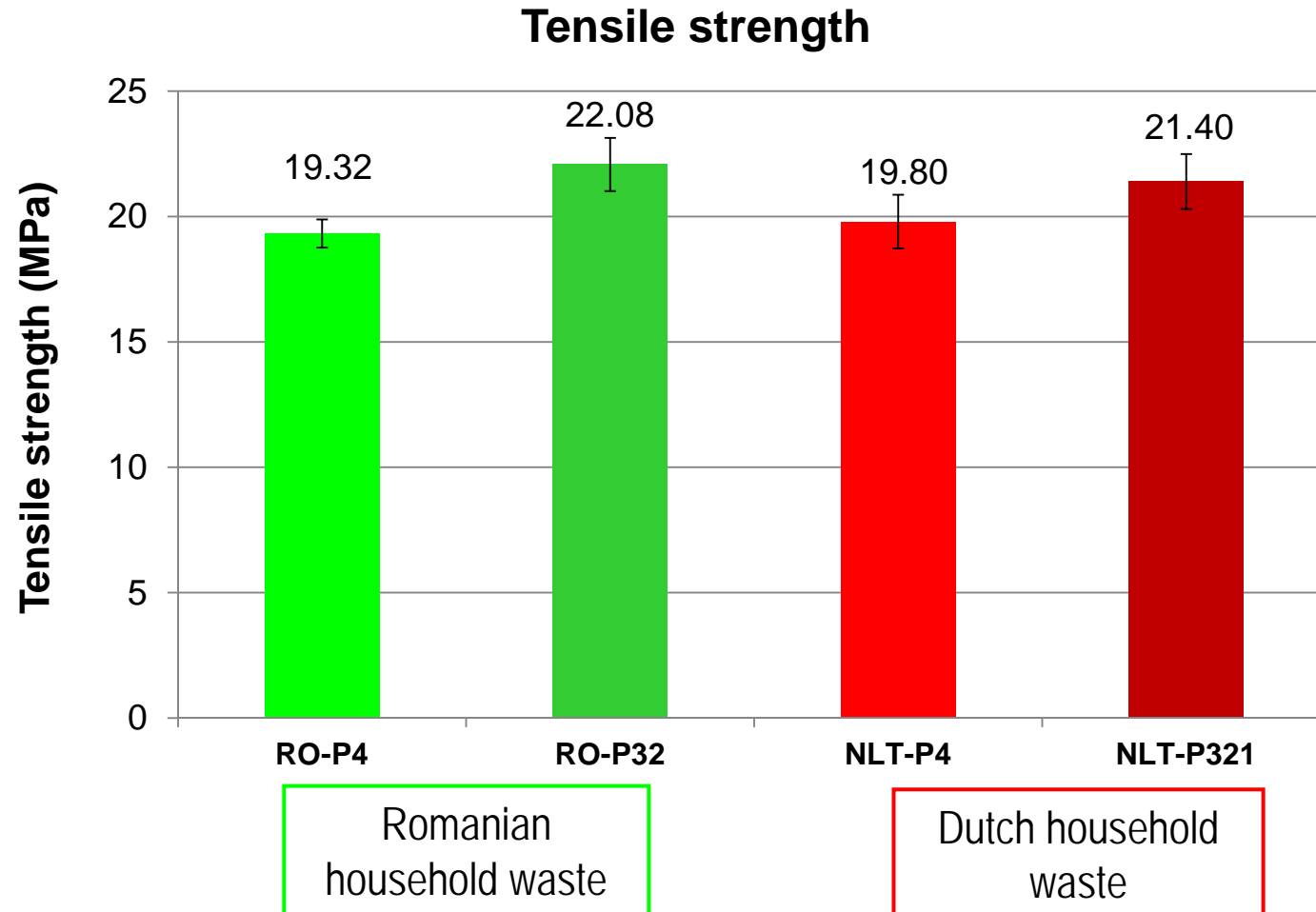
P2 (PE): 100%

P1 (PE): 100%

W2Plastics products tests



W2Plastics products tests



	Density kg/m ³
P4	880-920
P3	920-960
P2	960-980
P1	970-990

Cutting density:
920 kg/m³

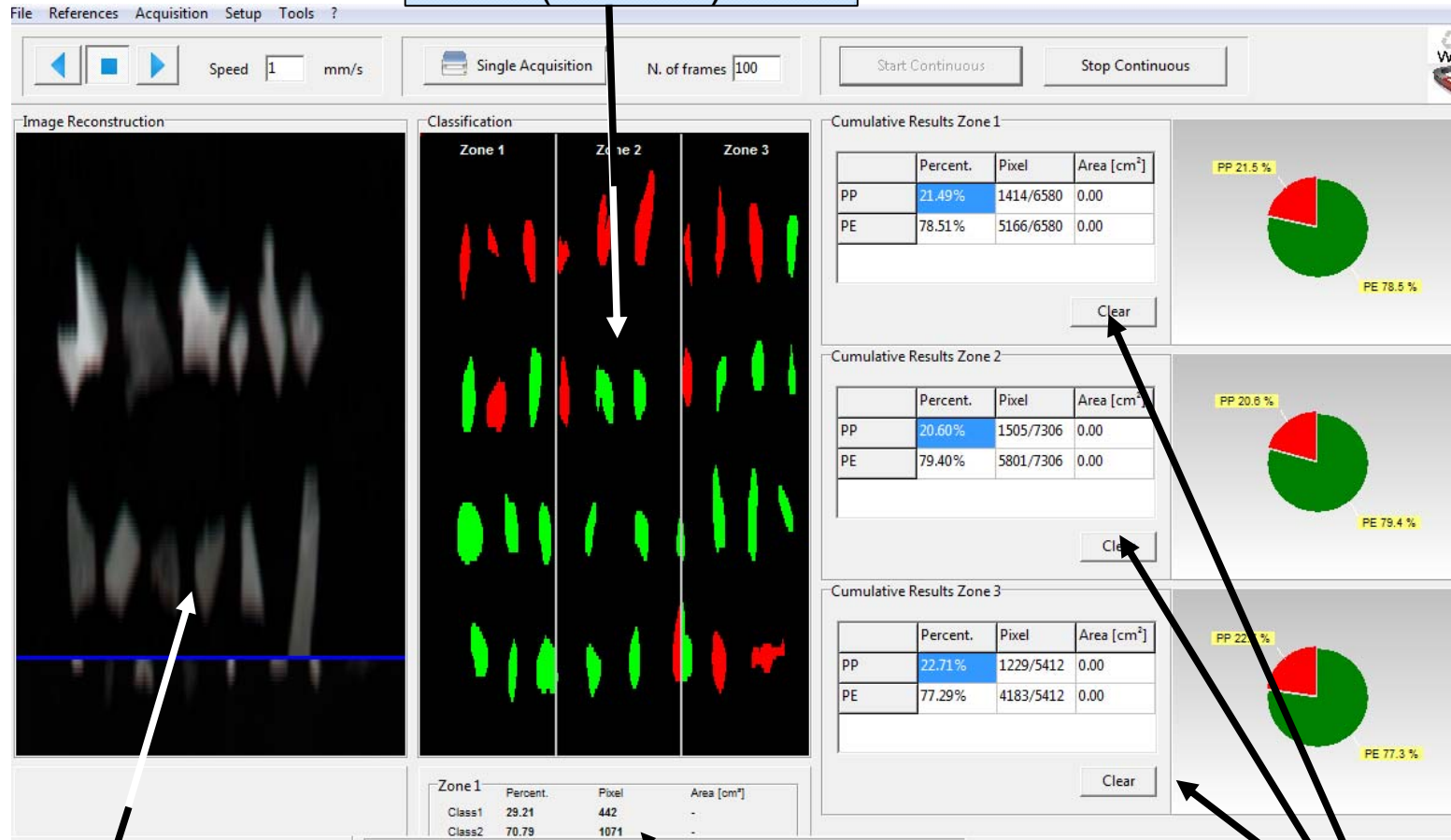
References:

PP: Moplen HP 400 H: 24 MPa

PE: TIPELIN BA 550-13: 27 MPa

W2Plastics products tests

Visual classification
(3 zones)



Real time acquisition window

Instantaneous results

Cumulative results



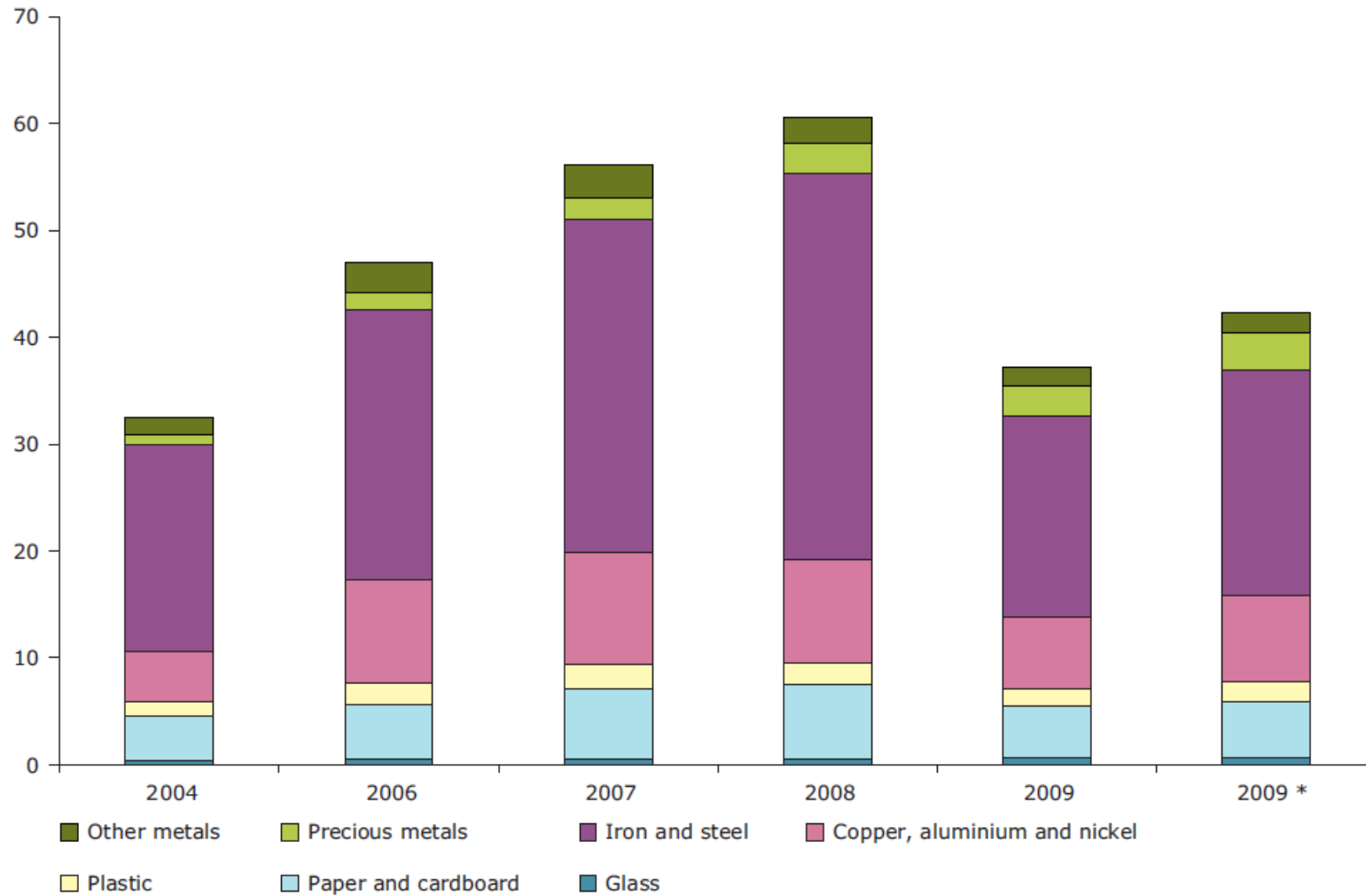
W2Plastics products tests

- Recovery of rigid PP and PE with both high grade and high recovery (>93% for PP, 96% for PE)
- Separation accuracy is $E_p = 5-6 \text{ kg/m}^3$
- Both PP and PE products have good mechanical properties

W2Plastics business case

Progress in recycling

Billion EUR in current prices



W2Plastics business case

East Europe case



	→	1 ton of rigid PP-PE mix	-200 €
Cutting & washing 150 €/t (in house)	→	0.7 t of clean PP-PE mix	-150 €
W2Plastics MDS 60 €/t	→	0.3 t PP 95% grade 0.4 t PE 95% grade Residue 5% (30 €/t)	-42 € -1 €
Compounding 150 €/t (in house)	→	0.3 t PP regranulate 0.4 t PE regranulate Melt filtration residue 2-3%	-105 € -0.5 €
Sales 800 €/t	→	0.3 t PP regranulate 0.35 t PE regranulate	520 €

COSTS= 200 € + 150 € + 43 € + 105 € = **498 €**

REVENUES= **520 €**

W2Plastics business case

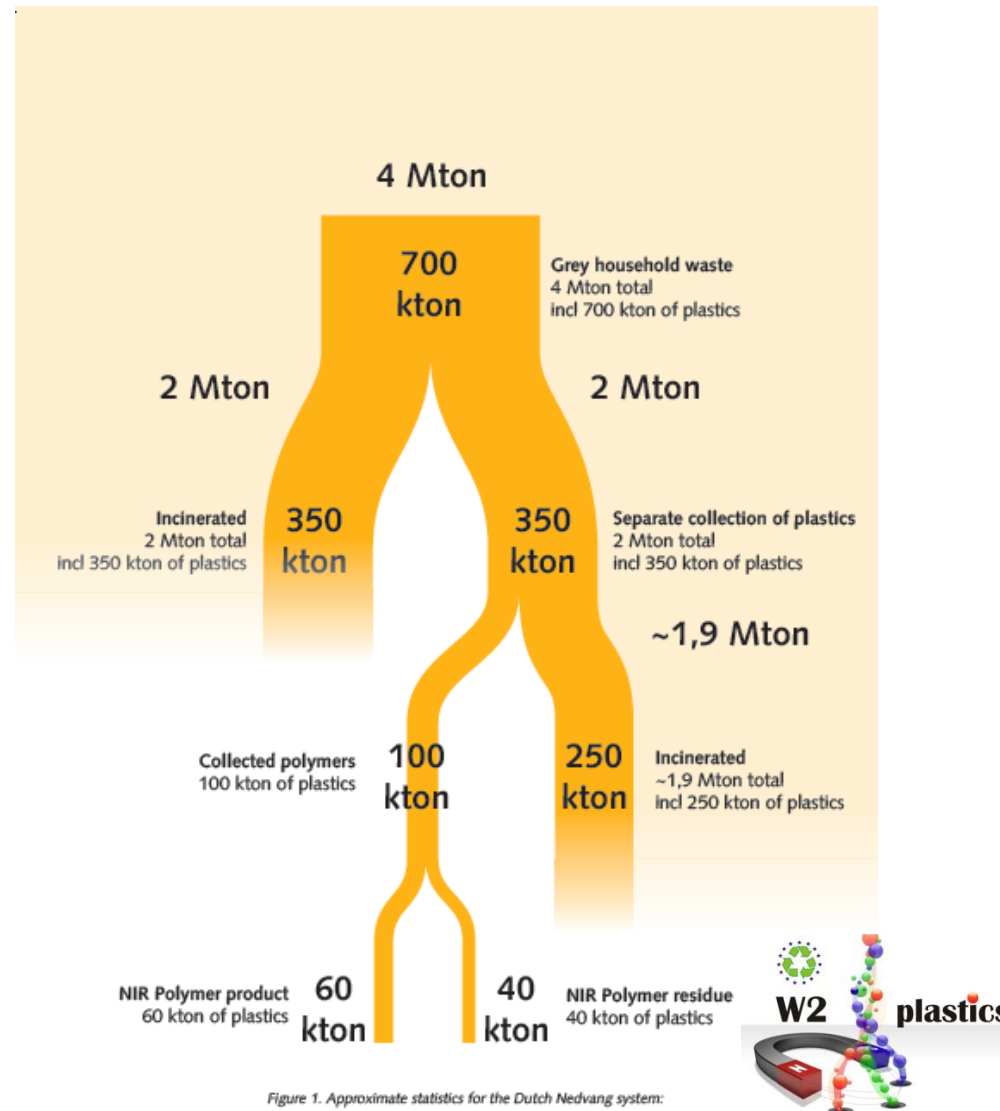


Figure 1. Approximate statistics for the Dutch Nedvang system: the recycling of separately collected packaging waste from households by NIR.

W2Plastics business case

West Europe case

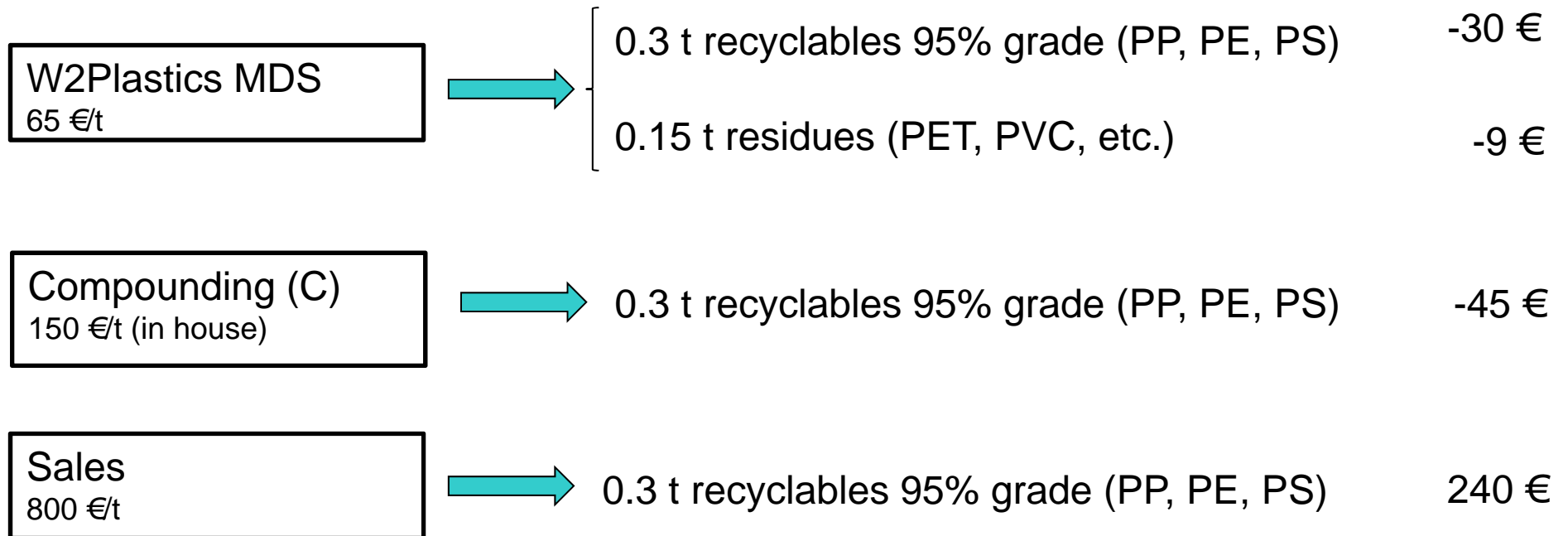
IR sorting → 1 ton of rigid and films plastic residue 70 €

Cutting & washing (CW)
200 €/t (in house) → 1 t of rigid and films plastic residue -200 €

Film removal (FR) → $\left\{ \begin{array}{l} 0.250 \text{ t films} \left\{ \begin{array}{l} 0.225 \text{ t light} \quad 0 \text{ €} \\ 0.025 \text{ t heavy (50 €/t)} \quad -1.5 \text{ €} \end{array} \right. \\ 0.450 \text{ t rigid plastics mix to MDS} \end{array} \right.$

W2Plastics business case

West Europe case



COSTS= (CW) 200 € + (FR) 1.5 € + (MDS) 39 € + (C) 45 € = **285.5 €**

REVENUES= 70 + 240 = **310 €**

W2Plastics pros and cons

Advantages

- Continuous and fast separation process
- High separation efficiency
- Not influenced by the particle shape and color
- High flexibility
- Low energy consumption
- Safe working conditions (compared to organic-water mixture sink-float)
- Environmental friendly (no hazardous residues)
- Fast and on line assessment
- Economically feasible

Disadvantages

- New technology

Project Title: Magnetic Sorting and Ultrasound Sensor Technologies for Production of High Purity Secondary Polyolefins from Waste (W2Plastics)

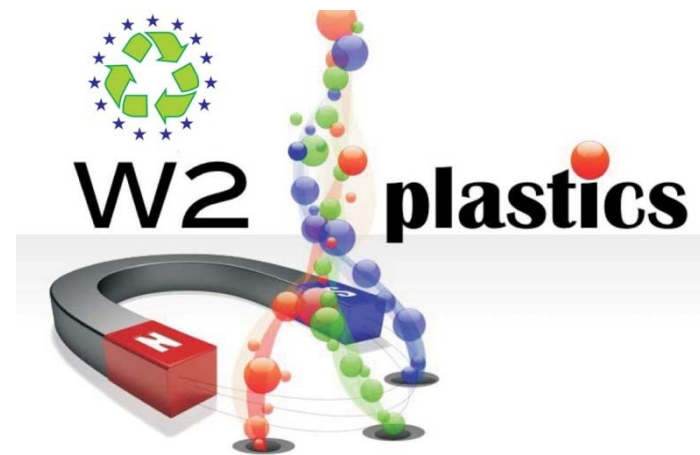
Budget: 3,9 MEuro

Participant no.	Participant organisation name	Country
1.	Delft University of Technology	The Netherlands
2	Universita' di Roma La Sapienza	Italy
3	Technical University of Denmark	Denmark
4	Transylvania University of Brasov	Romania
5	Barcelona Supercomputing Centre Centro Nacional de Supercomputación	Spain
6	Budapest University of Technology and Economics	Hungary
7	Recycling Avenue	The Netherlands
8	Alcufer kft	Hungary
9	Urban S.A.	Romania
10	Oldelft	The Netherlands
11	DV – Technologie d'Avanguardia s.r.l.	Italy
12	REDOX Waste Recycling B.V	The Netherlands

Thank you for attention

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