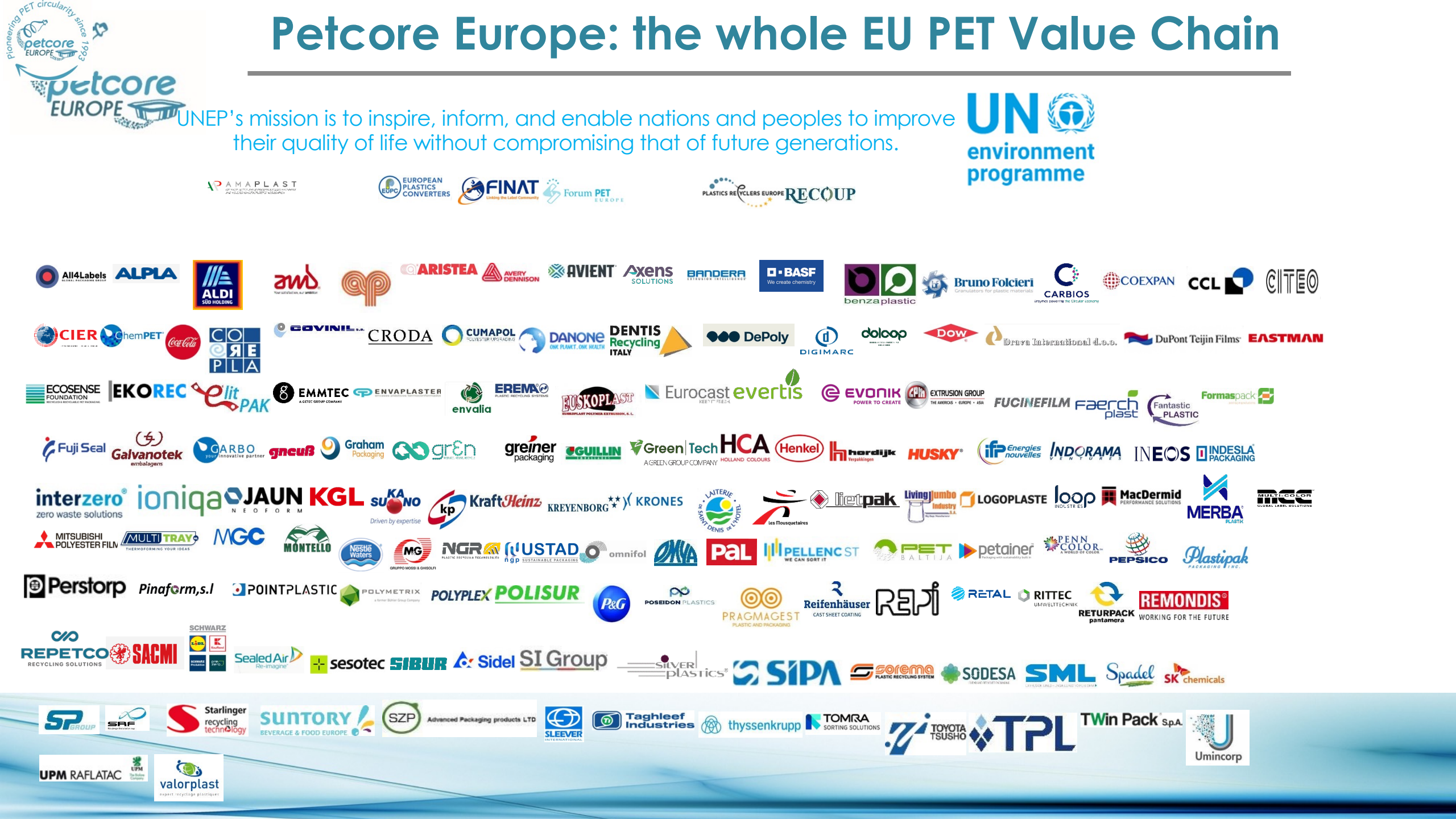
# Standardization

## Design for Recycling and Recyclability assessment

# Petcore Europe: the whole EU PET Value Chain

UNEP's mission is to inspire, inform, and enable nations and peoples to improve their quality of life without compromising that of future generations.

UN environment programme



**Sleeves and labels**

Avery Dennison
All4Labels
CCL Label
Finat
Fuji Seal Europe
Multi-Color Corporation
Sleever International
UPM Raflatac

**Masterbatches & additives**

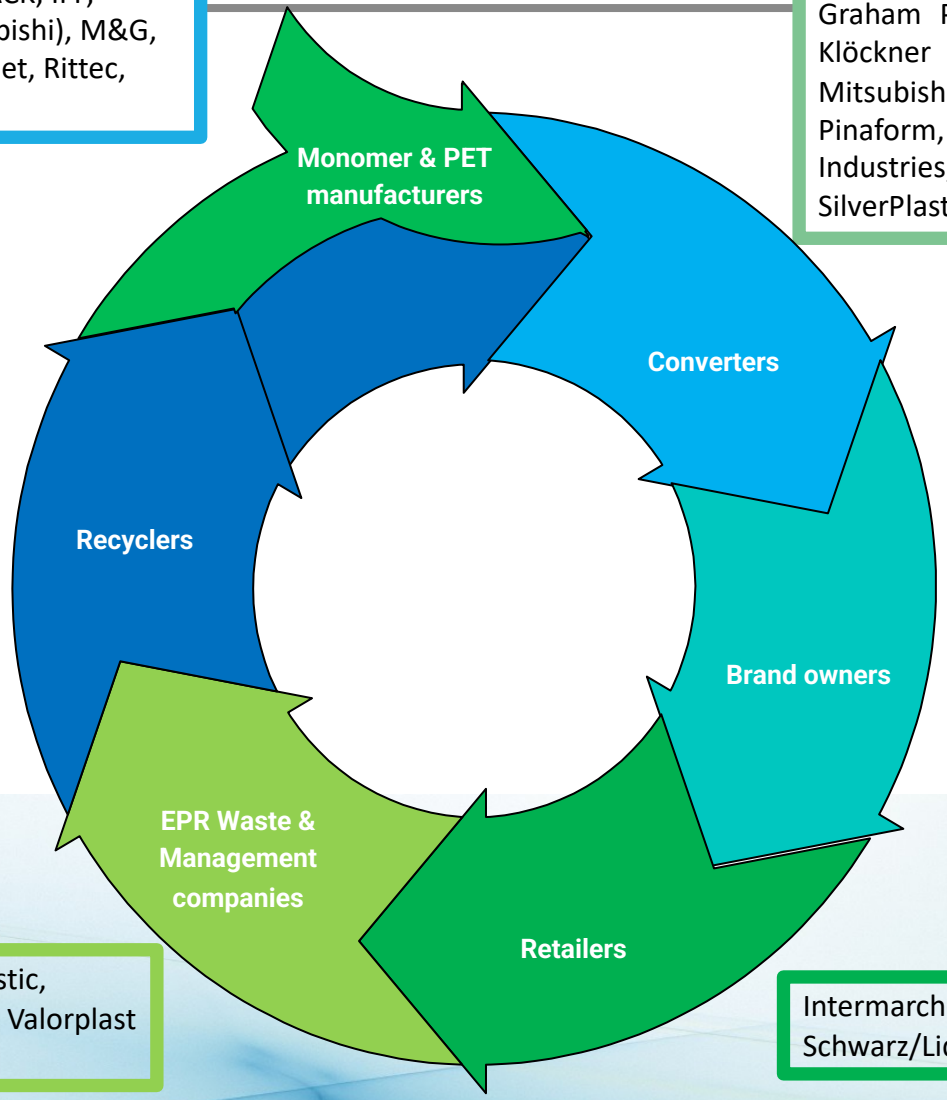
Clariant
ColorMatrix
Holland Colours
MacDermid
Penn Color
Point Plastic
SI Group
Sukano

**Machinery Producers**

AMAPLAS, Bandera, Erema, Folcieri,, Gneuss,Husky, NGR, Pellenc ST, Polymetrix, Sesotec, SIPA, Sorema, Starlinger, TOMRA, Uhde Inventa-Fischer, Krones, Extricom Extrusion GmbH

Axens, BASF, BP, CARBIOS, CURE, Doloop, Eastman, Evonik, Garbo, FORMAS PACK, IFP, Ioniqa, Loop Industries, MGC (Mitsubishi), M&G, Perstorp, Poseidon Plastics, PET Planet, Rittec, Sibur, SK Chemicals, Toyota Tsusho

AMB Packaging, Aristea, Arcoplastica, Benzaplastic, COEXPAN, Covinil, Teijin Films, Dow DuPont, Envalia, EuPC, Ekorec, Eukoplast, Eurocast, Evertis, FAERCH Plast, Forum PET Europe, Fucinefilm, Formas Pack, Galavanotek, Graham Packaging, Guillin Emballages, Hordijk, Indesla, Klöckner Pentaplast, Lietpack, Logoplaste, Merbaplastic, Mitsubishi, NGP MUSTAD PACKAGING SM SA, Omnifol, Pinaform, S.L., Polyester Films, Plastipak, Polyplex, RETAL Industries, RomcarbonLivingJumbo, Sealed Air, Sidel, Sirap, SilverPlastics, Sodesa, SRF Limited, SZP, TPL



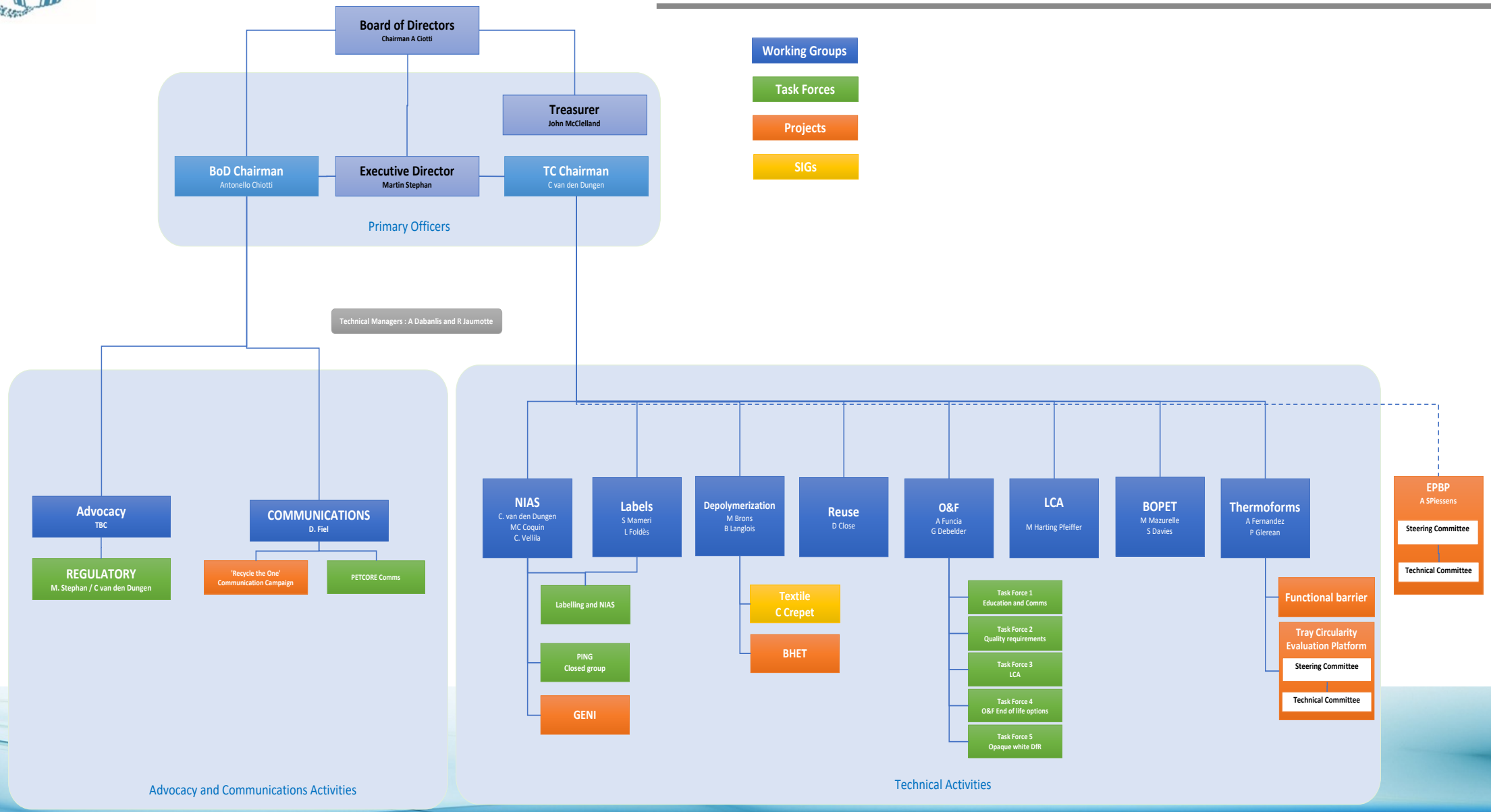

Alpla, Cier, Dentis, Envalia, Evertis, Faerch, Fantastic Plastic, GreenTech, Montello, Novelplast, PET Baltija, Plastipak, PRE, Remondis, Wellman, Schwarz/Lidl Suez, Umincorp

Coca-Cola, Danone, Henkel, Kraft Heinz, LSDH, L'Oréal, P&G, PepsiCo, Spadel, Suntory

Citeo, Corepla, Fantastic Plastic, Remondis, Returpack, SUEZ, Valorplast

Intermarché - Les Mousquetaires, Schwarz/Lidl

# Organisation: Towards Circularity



# Context of the initiative

- During CPA discussions and during consultations of stakeholders on how to boost the recycling industry it was raised that there were multiple design guidelines not facilitating the development of an EU-wide fluid recycled plastics market
- The commission then mandated CEN to work on the development of recyclability assessment to standardize DfR and REP
- The recyclability of packaging will be part of PPWR and used to ban the ones considered not recyclable.
- The standard will cover all plastic packaging to give a level playing field 15 parts in the standard)
- There are different subgroups in TC261/SC4WG10 dealing with the different parts of the standard
- We are actually in the second round of revision of comments coming from the stakeholders (notional standardization bodies, commission, liaison organization)

# Objectives of the standardization work

- Be able to assess recyclability with one standard throughout Europe (and avoid multiple approaches)
- Grade the recycability from A ot E
- Use this recyclability score to ‘push’ the value chain in the right direction towards ‘A’
- Grading can be used for the ecomodulation of EPR fee
- Grading will be used to ban the worst (Graded E) solutions from the market
- Define protocols to assess recyclability to make sure the assessment is done in a repeatable manner and fair to all players

# Planning

| | 06/23 | 07/23 | 08/23 | 09/23 | 10/23 | 11/23 | 12/23 | 01/24 | 02/24 | 03/24 | 04/24 | 05/24 | 06/24 | 07/24 | 08/24 | 09/24 | 10/24 | 11/24 | 12/24 | 01/25 | 02/25 | | 08/25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Draft consultation (WG10 level) | 01/06 | | 31/08 | | | | | | | | | | | | | | | | | | | | |
| Subgroups deal with comments | | | | 01/09 | 09/10 | | | | | | | | | | | | | | | | | | |
| Draft consultation (SC4 level) | | | | | 10/10 | | 04/12 | | | | | | | | | | | | | | | | |
| Subgroups and WG10 deal with comments | | | | | | | 05/12 | | | 03/03 | | | | | | | | | | | | | |
| CEN admin time, WG10 isn't allowed to work on documen | | | | | | | | | | 04/03 | | | 03/06 | | | | | | | | | | |
| CEN inquiry (TC261 + TC in liaison) | | | | | | | | | | | | | 03/06 | | 26/08 | | | | | | | | |
| Subgroups and WG10 deal with comments | | | | | | | | | | | | | | | 27/08 | | | | | | 24/02 | | |
| NSB inquiry on wording, WG10 isn't concerned | | | | | | | | | | | | | | | | | | | | | 24/02 | | |
| NSB final votes | | | | | | | | | | | | | | | | | | | | | | 05/05 30/06 | |
| Admin and publication | | | | | | | | | | | | | | | | | | | | | 24/02 | | 26/08 |

# The main elements of the standardization

First 2 questions to ask:

- Which is the targeted application of the recyclate to be produced from the wastes ?
  → bottles, trays, fiber,…
- What is the process that will be used to produce this recyclate ?
  → Mechanical recycling, manual or automated sorting, hot/cold wash,…

Then build:

- traffic light table on the components (Body, caps, labels,…) and constituents (barriers, colorants,…) of the bottles
- Testing procedures simulating the industrial reality to be able to perform testing in laboratory

# Example

| | Recycling Technology | Targeted for the main body | At scale outlet for the main body | Multiple loop or open loop | Grading |
|---|---|---|---|---|---|
| | Unit Operations described in Part 10 | DfR's should be defined with this targeted application in mind | This is where it actually goes and the DfR's should neither perturbate this stream | Resulting from 'at scale' outlet | Impact of open or closed loop |
| Clear PET Bottles | Mechanical Recycling | Bottles | Bottles | Multiple loop | Maximal |
| Colored PET Bottles | Mechanical Recycling | Bottles | Fiber | Open loop | Reduced to trigger reactions of the value chain |
| Opaque PET Bottles | Mechanical Recycling | Bottles | Fiber | Open loop | Reduced to trigger reactions of the value chain |
| White opaque PET Bottles | Mechanical Recycling | Bottles | Bottles | Multiple loop to be confirmed | Maximal |

# Traffic light table

| Transparent clear and light blue bottles | GREEN<br>Full compatibility –<br>materials that passed the testing protocols with no negative impact<br>OR<br>materials that have not been tested (yet), but are known to be acceptable in PET | YELLOW<br>Limited compatibility –<br>materials that passed the testing protocols if certain conditions are met<br>OR<br>materials that have not been tested (yet), but pose a low risk of interfering with PET | RED<br>No or low compatibility –<br>materials that failed the testing protocols<br>OR<br>materials that have not been tested (yet), but pose a high risk of interfering with PET |
|---|---|---|---|
| **Material** | PET | | PLA; PVC; PS; PETG |
| **Colours** | Transparent clear and light blue bottles | | Opaque;<br>Fluorescent;<br>Metallic,<br>Other colors |
| **Barrier** | SiOx plasma coating; | Carbon plasma coating, Nylon MXD6 in a 3-layer structure with up to 5wT%<br>Nylon -MXD6 and no tie layers;<br>Polyglycolic Acid multilayer,<br>Polytrimethylene Napthalate (PTN) blended with PET | Nylon MXD6 in a 3 layer structure with >5wt%;<br>Nylon MXD6 in a 5-layer structure;<br>Monolayer Nylon MXD6 blend<br>EVOH |
| **Additives** | | UV stabilizers; AA blockers;<br>Optical brighteners; oxygen<br>scavengers | Bio-/oxo-/photodegradable<br>additives.<br>Nanocomposites |
| **Closure Systems** | PE, PP;<br>all with density <1 g/cm$^3$ | | Materials with density >1 g/cm$^3$<br>(e.g. highly filled PE; metals); inseparable during recycling closures. Foamed PET.<br>Any other floatable or non-floatable materials made of wood or cellulosic materials. |
| **Liners, Seals and Valves** | PE; PE+EVA; EVA; EMA; PP; TPO; EPE and EPP all with density <1g/cm$^3$. TPS with density < 0,95g/cm3 | Floatable Silicon (density <1g/cm$^3$) | Materials with density >1 g/cm$^3$<br>(e.g. PVC, silicon, metals), silicone (even with density<1g/cm3. Foamed PET.<br>Any other floatable or non-floatable materials made of wood or cellulosic materials. |
| **Labels** | Labels with partial bottle coverage PE; PP; OPP; all with density <1 g/cm$^3$ | Lightly metallized labels (density<br><1 g/cm$^3$); paper with partial coverage; Foamed PET; | Materials with density >1 g/cm$^3$<br>(e.g. PVC; PS; PET; PETG; PLA);<br>metallized materials;<br>non-detaching or welded labels;<br>foamed PETG (even with density <1 g/cm$^3$); PET with washable inks; Ink coverage that prevents floatability; Paper with full coverage. |
| **Sleeves** | Sleeves with partial bottle coverage in PE, PP, OPP, all with density <1 g/cm$^3$. | Full sleeves that allow the PET bottle to be detected via NIR, in PE, PP, OPP, EPS, all with density <1 g/cm$^3$<br>Foamed PET; PET based sleeve with density<1. | Full body sleeves that prevent correct NIR/VIS sorting.<br>Materials with density >1 g/cm$^3$<br>(e.g. PVC; PS; PET; PETG);<br>Metallized materials; Ink coverage that prevents floatability; Foamed PETG (even with density <1 g/cm$^3$); PET with washable inks |
| **Tamper Evidence Wrap** | PE; PP; OPP; all with density <1 g/cm$^3$, Unprinted CPET | Foamed PET; | Materials with density >1 g/cm$^3$<br>(e.g metal; PVC; PS; PETG); metallized materials;<br>foamed PETG (even with density <1 g/cm$^3$); PET with washable inks |
| **Adhesives** | Alkali/water releasable.<br>Adhesives that remain stuck to the label once released. | Adhesive that is released and goes to the washing solution. | Adhesives stuck to the bottle once released. Adhesives non-releasable or releasable above 80°C |
| **Inks for labels, sleeves and direct printing** | Inks and coatings compliant with *EuPIA Exclusion Policy for Printing Inks and Related Products.* | | Inks that bleed;<br>Inks and coatings NOT compliant with *EuPIA Exclusion Policy for Printing Inks and Related Products*<br>Metallic inks<br>PVC based binders |
| **Direct Printing** | Laser marked or printed production or expiry date. | | Any other direct printing on the body of the bottle. |
| **Other Components** | Base cup, handles or other components made of PE or PP which are separated by grinding and float/sink - all with density <1 g/cm$^3$; Transparent clear or light blue PET | | Materials with density >1 g/cm$^3$ (e.g. metal, RFID tags); non-detaching or welded component.<br>Any other floatable or non-floatable materials made of wood or cellulosic materials. |

# Standard process

| Step # | Unit operation | Process description |
|---|---|---|
| 0 | Control Selection | Before any testing, control material to compare the evaluated packaging needs to be selected. The selection of the control material needs to be approved by the technical committee. |
| 1 | Delabelling | |
| 2 | Sortability evaluation by means of IR sorting or color sorting | Testing to ensure the PET container is sortable, after compaction, via NIR or other sorting technologies into the correct stream<br>The testing will be performed as per PART 2 of this standard. |
| 3.1 | Pre-treatment: grinding | Control and evaluated application PET containers are separately ground in order to fit the throat of a standard laboratory extruder. |
| 3.2 | Pre-treatment - Prewashing | Pre-washing is performed in an agitated (at ~240 rpm) vessel at 80°C for 5 minutes in a solution of 1% NaOH and a suitable detergent present on a list maintained by the Steering Committee as Described in the Methodology Standard. And Dosage is also described in the list mentioned above. Wash solution and PET Flakes are mixed at a ratio of 1:4. The flakes are subsequently separated from the pre-washing solution and transferred to the next step. Separation includes a path over a vibrating table and through a centrifuge. |
| 3.3 | Pre-treatment - Washing | The two bottle flake materials will be washed according to a standard European wash protocol with flake friction. Process is carried out at 80°C with 1% caustic and detergent selected among an agreed list and at ~240rpm. |
| 3.4 | Pre-treatment - Hot rinsing | Hot rinsing is performed in an agitated (~240rpm) vessel at 80°Cfor 3 min and 20sat a ratio of PET flakes to water of 1:4. The flakes are subsequentlyseparated from the hot rinsing water and transferred to the next step. Separation includes a path over a vibrating table and a centrifuge drier. |
| 3.5 | Pre-treatment - Cold rinsing and floatation | Following the hot rinsing, the flotation process allows PET flake separation from polyolefins (caps and labels) by density as occurring in the float/sink tank used in an industrial recycling line. |
| 3.6 | Pre-treatment - Drying | Reduce the flake moisture with hot air to release surface moisture to less than 1%. |
| 3.7 | Pre-treatment: air elutriation | Control and evaluated application; PET flakes are separately elutriated with air to remove light fraction. |
| 4.1 | Extrusion – flake blends preparation and composition | Once the materials from the control and evaluated application have separately gone through all pre-treatment steps (2.1-2.5) blending with the reference material will be prepared as per agreed test program. Standard blending ratios are 2, 5, 10, 25, and 50% |
| 4.2 | Extrusion – pellet production | Flakes are dried to reduce moisture as carried out in an industrial line. They are then extruded and filtered and pelletized into cylindrical pellets. |
| 5 | Crystallization and SSP | These operations will be performed to:<br>• either assess IV increase rate and then assess the colour on plaque moulding these pellets (4.1, route 1)<br>• or to be injected into preforms and then blow moulded to assess bottle performance (4.2, route 2) |
| 5.1 | Conversion – Plaques | Route 1: Once PET pellets have been produced and tested, reference pellets and samples will be mixed at 50% and standardized plaques will be moulded to assess colour. |
| 5.2 | Conversion – preform injection and bottles blow moulding | Route 2: Once PET pellets have been produced the applicant will convert them in preforms and bottles and performances of the bottle will be assessed. |