El ambiente es de todos | Minambiente

2do Seminario Internacional Online sobre Contaminantes Orgánicos Persistentes

Experiencias en mejores técnicas disponibles y mejores prácticas ambientales

MGG POLYMERS

WEEE Plastic Recycling

Achievements and challenges in the WEEE plastics circular economy

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Exponential increase of CO2 Emissions

Comparison 2000: 370 ppm

https://climate.nasa.gov/climate_resources/24/

- CO_2 is not visible and can be emitted without any costs
- Personally I consider this to be the world largest environmental threats – “Global Warming”
- And……..this CO_2 discussion is completely separated from any discussions about POPs

The production of virgin tech-polymers

Procurement

- Oil is extracted
- Transported to refineries
- Non-renewable resource
- Global market

Processing

- Huge refineries produce fractions
- Polymerisation plants polymers
- Huge amount of energy needed
- Some 100 GigaJoule per MT

Selling

- Virgin plastics
- Produced in large quantities
- Volatile prices
- Global market

The production of PCR tech-polymers

Procurement

- WEEE (E-Waste) plastics
- Growing supply
- Produced by WEEE recyclers
- Regional market

Processing

- Mechanical ‘mining’ process
- Innovative technologies
- < 10% of energy
- Save about 3-4 tons CO_2/ton PCR

Selling

- 100% PCR tech-polymers
- Virgin-like quality
- Stable prices
- For “green” sustainable products

TED Talk of Mike Biddle

- It is difficult to share video sequences in a virtual setting.
- My recommendation is to have a look at this TED talk:

  https://www.ted.com/talks/mike_biddle_we_can_recycle_plastic

Agenda

- WEEE plastics recycling in Europe
- Volume, Quality, Returns of WEEE plastics
- LCA of the recycling of WEEE plastics
- WEEE Plastic pre-processing and recycling in China
- Sorting techniques
- The example of the complicated legislation with example BFRs

This session is only about WEEE plastics

Many types of WEEE plastics.....

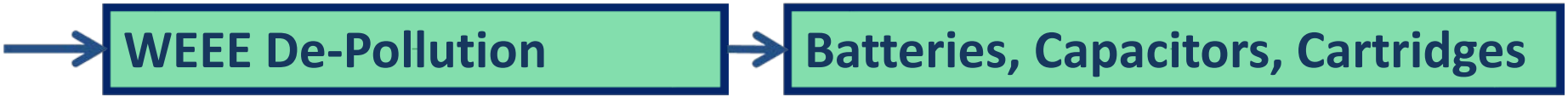
SDA

Fridges

ICT

CRT Displays

WEEE treatment starts with a de-pollution step

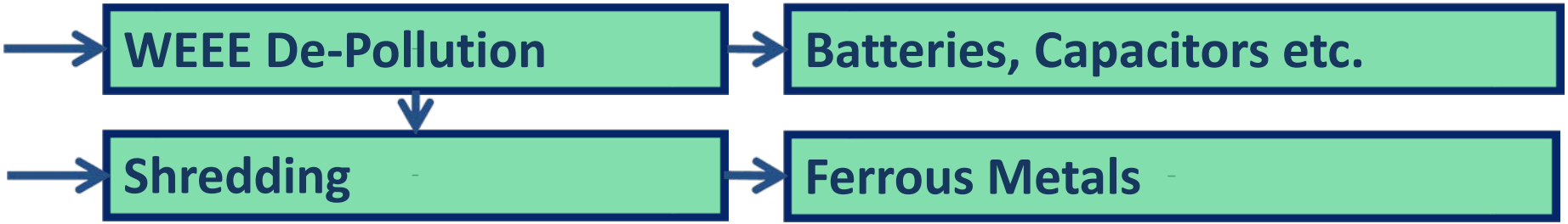


De-Pollution is a legal requirement…..

De-Pollution with a „Smasher“

- **Müller-Guttenbrunn Group Patent**
- **What is taken out?**
  - **Compenents such as**
    - Capacitors > 25mm
    - Batteries
    - Toner Cartridges
  - **Valuable components, such as**
    - Printed Circuit Boards
    - E-Motors and spools
  - **Disturbing fractions, such as**
    - Wood
    - Fibres and textiles

Treatment of the de-polluted WEEE



MGG Metrec operates a specialized Shredder Technology for WEEE

EVA Shredder, tailored to treat WEEE

WEEE Shredding

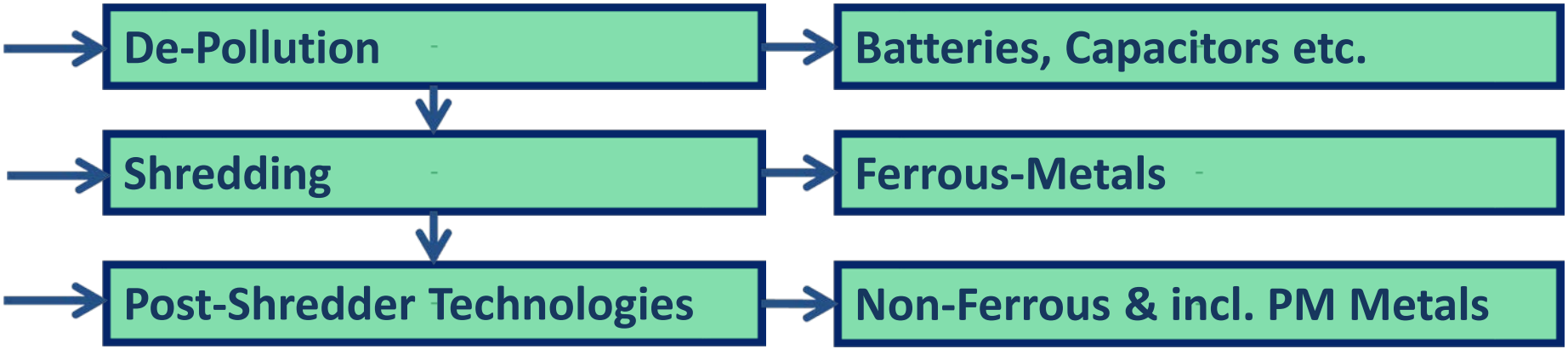
- Extreme efficient air treament
- Fire fighting techniques
- Noise reduction

Separation of ferrous metals

Shredder residues

- Heavies
- Lights
- Dust
- …and clean air (<2 mg/m3 of dust)

Treatment of the WEEE Shredder Residues



MGG Metran separates non-ferrous metals

Post-Shredder Technologies for Shredded WEEE

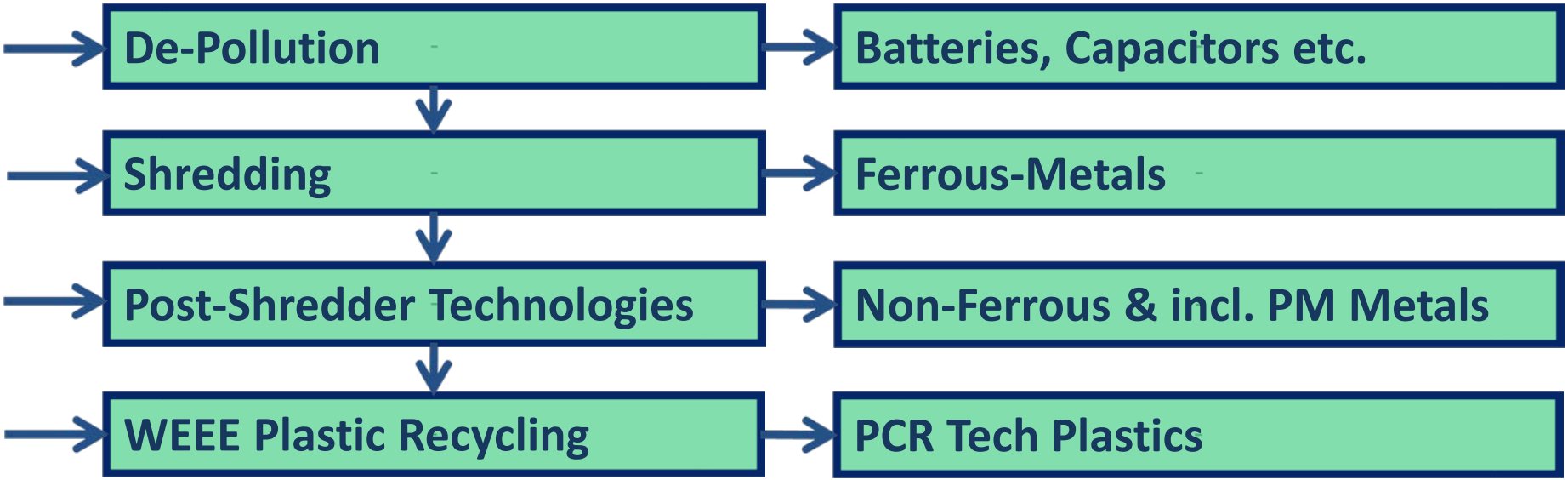
- **“Heavies” and “Light” Shedder Residues**

- **Dry, Wet and High-Tech Separation Techniques:**
  - Sieving
  - Heavy Media Separations (HMS)
  - Induction based (Eddy Current)
  - Sensor based separation techniques
  - Small grain separations etc.

- **The result consist of concentrates:**
  - Non-ferrous Metals (Copper, Aluminium, Zinc, Brass, Precious Metals)
  - Printed Circuit Boards
  - A wild mix of tech plastics

MGG Metran is a “Post-Shredder Technology” Specialist

Plastic Recycling from WEEE



MGG Polymers treats the last remaining fraction

MGG Polymers WEEE Plastics Recycling

- **Goods-In and Pre-processing**
  - Each receipt is assayed
  - Material cleaned from non-plastics
- **High-tech plastic separation**
  - Cleaning and separarions
  - PP, HIPS, ABS and PC-ABS
- **Blending, Extrusion and Compounding**
- **Lab Analyses RoHS Physical, Chemical & Rheologic parameters**

Output Material some 25 000 MT of PCR plastics drop-in replacing virgin

Some examples of products with 100% MGG Polymers PCR Plastics

Post-Consumer Recycled Plastics (**PCR Plastics**)

This is different from Post-Industrial Recycled Plastics **(PIR plastics)**

What is possible with 100 % PCR Plastics

Post-Consumer Recycled Plastics (**PCR Plastics**)

These PCR plastics are REACH and RoHS compliant

“Forward” Approach

Plastics volume in terms of demand for EEE (Europe)

Total Converter Demand
49,9 Mio MT

Quelle Plastics Europe

The demand for EEE is approx. 3.1 Mio MT’s in Europe

“Reverse” Approach

Estimating the quantity of plastics in WEEE (Europe)

European Market	Mio MT	in %
Placed on Market (POM) EEE	9,50	
Officially reported collections/recycling	3,30	35%
Informal collections/recycling	3,20	34%
Exports (of which 1,3 Mio MT not documented)	1,50	16%
"Scavenging" for parts	0,75	8%
Losses (such as through waste bin)	0,75	8%

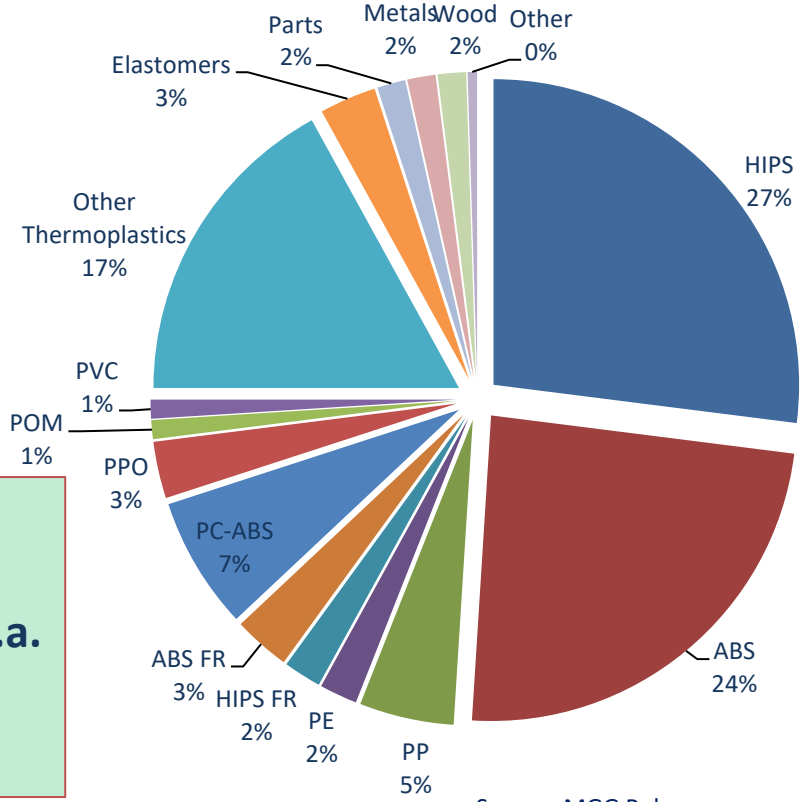
WEEE Plastics some 1,4 Mio MT

Plastic Content in WEEE per category	
SDA	30%
LDA	15%
ICT	20%
Tools	10%
Temp Control Equipm.	25%
Screens	20%

Source CWIT – MGG Polymers

Qualitative Approach
Average composition of WEEE plastics for recycling

WEEE Plastics	
ABS	24%
HIPS	27%
Polyolefines	7%
PC and PC-ABS	7%
Other plastics incl. BFR	29%
Parts and metals	4%
Other (mainly wood)	2%



Source: MGG Polymers

Recycling WEEE Plastics at a yield of some 60 % has the potential of **3.8 Mio Metric Tons of CO2 savings p.a.**

The equivalent of a 440 000 inh. city

Scientific Approach

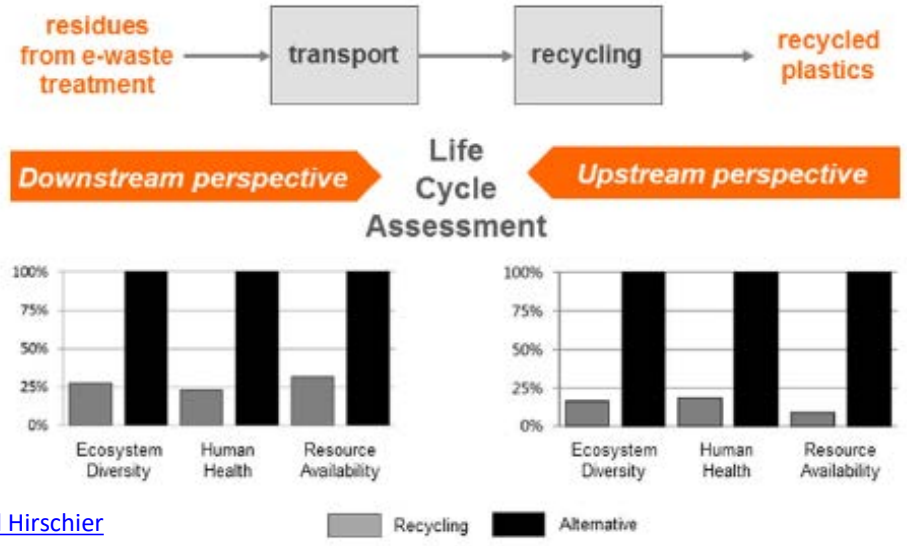
LCA PCR WEEE Plastic versus

1. **Incineration of WEEE plastic and**

Recycling PCR WEEE plastics 4 times better than Municipal Solid Waste Incineration

2. **Production virgin plastics**

Recycling PCR WEEE recycling option 6-10 times better than producing virgin plastics



Source: [Science of the Total Environment 529 (2015) 158–167, Patrick Wäger, Roland Hirschier]

If WEEE plastics recycling makes so much sense, why is there so little of it……

- It is difficult.....

Separation of plastic is difficult

Source: Mike Biddle, TED Talk

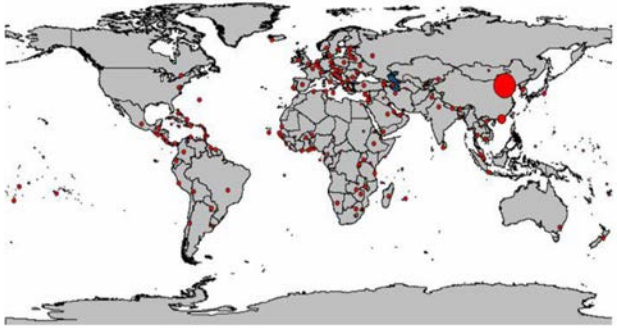
If WEEE plastics recycling makes so much sense, why is there so little of it……

- It is difficult.....
- Most of the material disappears from Europe

“The ways of plastics....”

The western Africa route

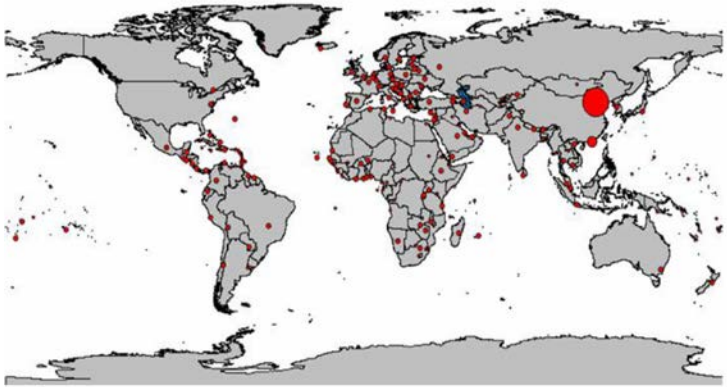
The China route



Resulting in losses of well over 1 Mio MT from the EU Urban WEEE Mine

The most frequently used route was for a long time....

- Export to China (8 Mio Metric Tons of waste plastics)
- Of that volume >3 Mio from Europe
- A lot of the WEEE plastics (no statistics)
- WEEE plastics notification duty in many countries



- This has stopped completely and moved to other parts of South East Asia
- Now export to the Far-East will become much more difficult („Norwegian Proposals“)

Not a stable market and it will become more difficult

Concerns

- **What happens with the non target plastics**
  - Discarding, landfilling or open-air incineration?
- **What happens with hazardous content?**
  - Brominated Flame retardants, Cadium in coloring agents etc.
  - Brominated Flame Retardants (BFR‘s) in toys – Matel case
- **How about health and safety hazards?**
- **This is why China has banned the import of mixed plastic wastes**
  - Started off with green fence, then National Sword followed by official ban
  - Active since January 1st 2018

But there is a market for re-processed plastics

It does not require a high-tech factory

- **Getting to a concentrated volume is the most important task**
  - How can it be organized that plastics „get together“ -> volume requried
  - It might need some grinding or pressing to allow plastic to travel over some distance
  - Ground plastics have a specific density of 3 cubic meter per metric tonne

- **Once together there are relatively easy techniques**
  - To get the metal out of the fractions to generate value
  - Even to get BFR‘s concentrated – but do we want that – see also UNIDO paper
  - Ideally this concerns wet-processing, but water might be a problem?

- **Let‘s discuss what infrastructure could be made available**
  - Logistics infratructure – loading unloading
  - What permitting is required -> Notification requirements as from 1/1/2021!!
  - It water, electricity etc. available

Let‘s create a value with plastics

Ways of preparing material for transport

But there are limitations of these simple techniques

- **Manual dismantling**
  - Don‘t count on plastics markings to be correct
  - Large pieces have a very low density (not more than 8 MT per full load)
  - If transport is needed, grinding or pressing is required

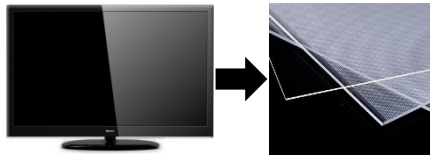
- **Pre-processing of plastics**
  - Grinding, cleaning and density baths
  - After „washing“ and wet separations a „spinning“ is required
  - Is water, electricity etc. available?

- **Some remarks about high-tech ID-ing of plastics**
  - Near Infra-Red – limited to light coloured plastics – no blacks
  - XRF handheld – watch out with radiation! – good equipment but not cheap

Let‘s create a value with plastics

Simple sorting methods

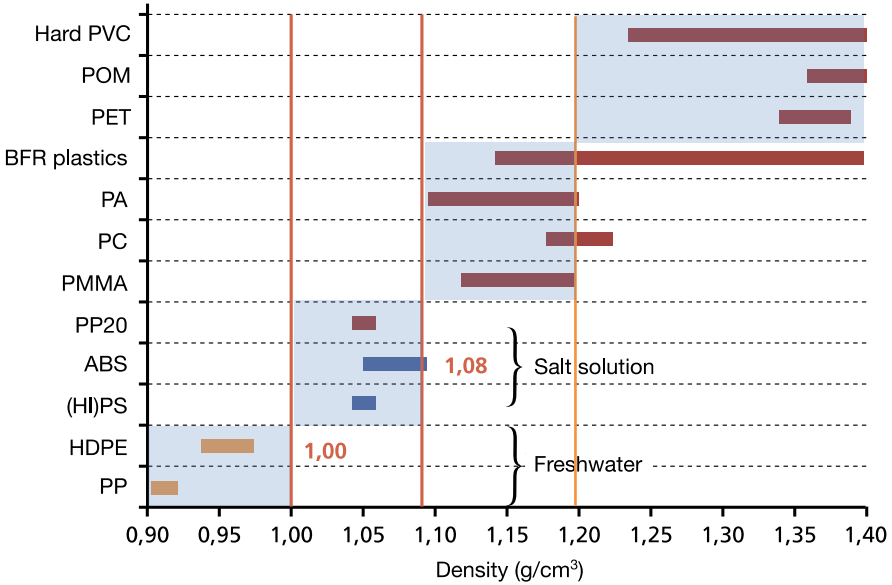
- Origin of plastic
- Markings (not always correct)
- Flexibility/breakability
- Sound when hit
- Density
- Reactions to solvents
- Smell when burnt (not recommended!)



Source: A.Haaarman EMPA

How to sort….

Density



Cheap & widely available

NaCl (Table Salt)	160g/L	360g/L (max)
KCl (Potash)	180g/L	
MgSO4 (Fertilizer)	140g/L	

Solvents

Acetone (nail polish remover)

-Makes ABS, PS and HIPS sticky;

-Leaves white mark for PC and PC-ABS.

Limonene (orange/lemon extract)

-Makes PS and HIPS sticky

Source: A.Haaarman EMPA

If WEEE plastics recycling makes so much sense, why is there so little of it……

- **It is difficult.....**
- **Most of the WEEE plasticmaterial disappears from Europe**
- **Very few companies invested in WEEE plastics recycling**
  - Due to the losses of material from Europe
  - As an ever increasing complexity of legislation

Let‘s look at Brominated Flame retardants as example

The compexity of the legal framework

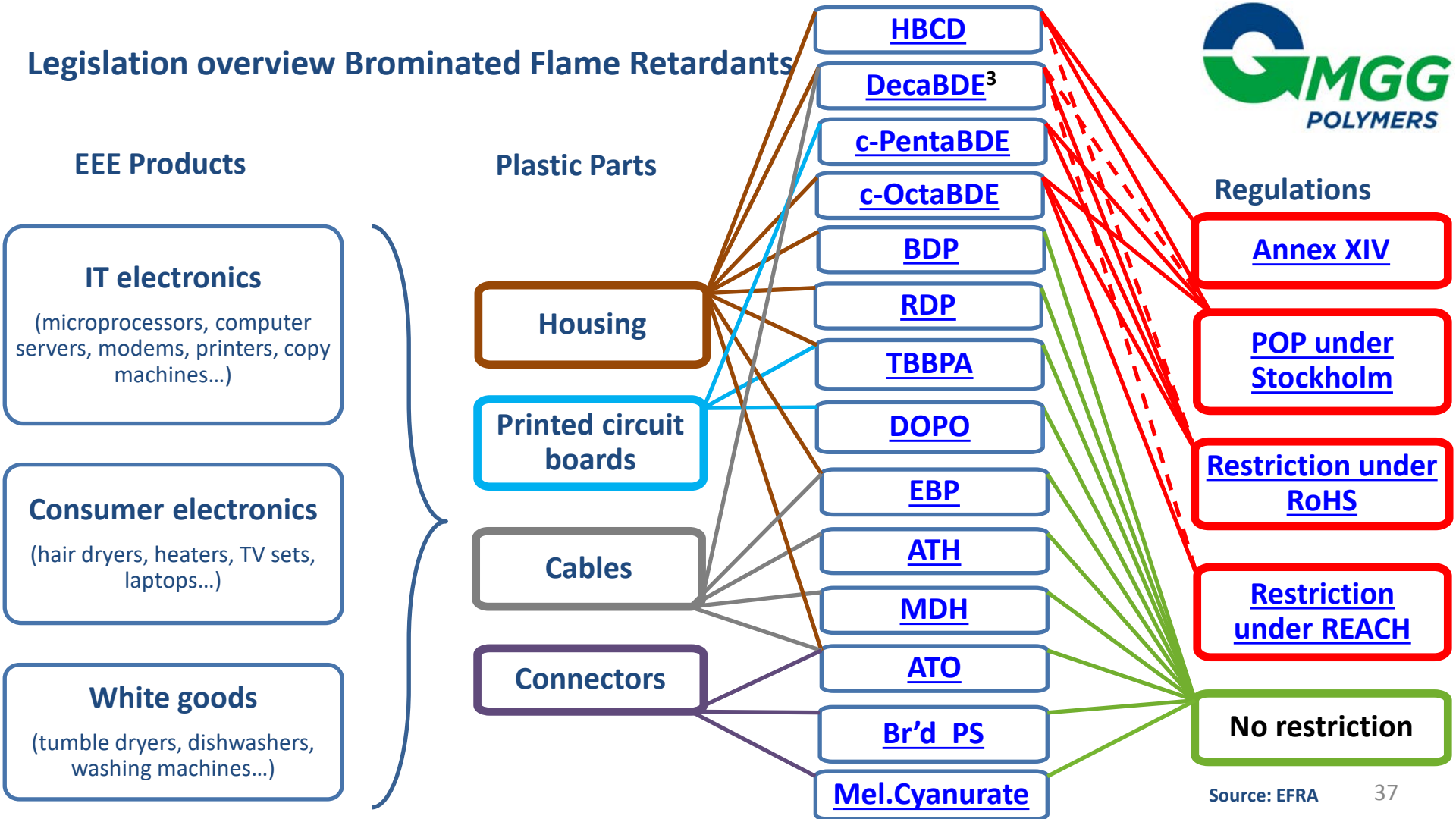
- **EU Waste Legislation**
  - EU Waste Framework Directive
  - EU Waste Shipment Regulation
  - EU WEEE Directive

- **UN Conventions**
  - Basel Convention -> transboundary shipments of waste
  - Stockholm Convention -> POP's
  - Rotterdam Convention -> hazardous substances & chemicals

- **Product Legislation**
  - EU General Product Safety Directive (GPSD)
  - REACH Regulation
  - RoHS Directive for EEE

A continuous flow of new legal initiatives

Legislation overview Brominated Flame Retardants



Source: EFRA

Deca-BDE as example of this complexity

- **RoHS 1 and 2 as well as WEEE Directive**
  - Discussions and decisions to stop using PBDE's in new EEE as from 2004
  - De-pollution criteria (subsequently in standards such as WEEE Labex and Cenelec)

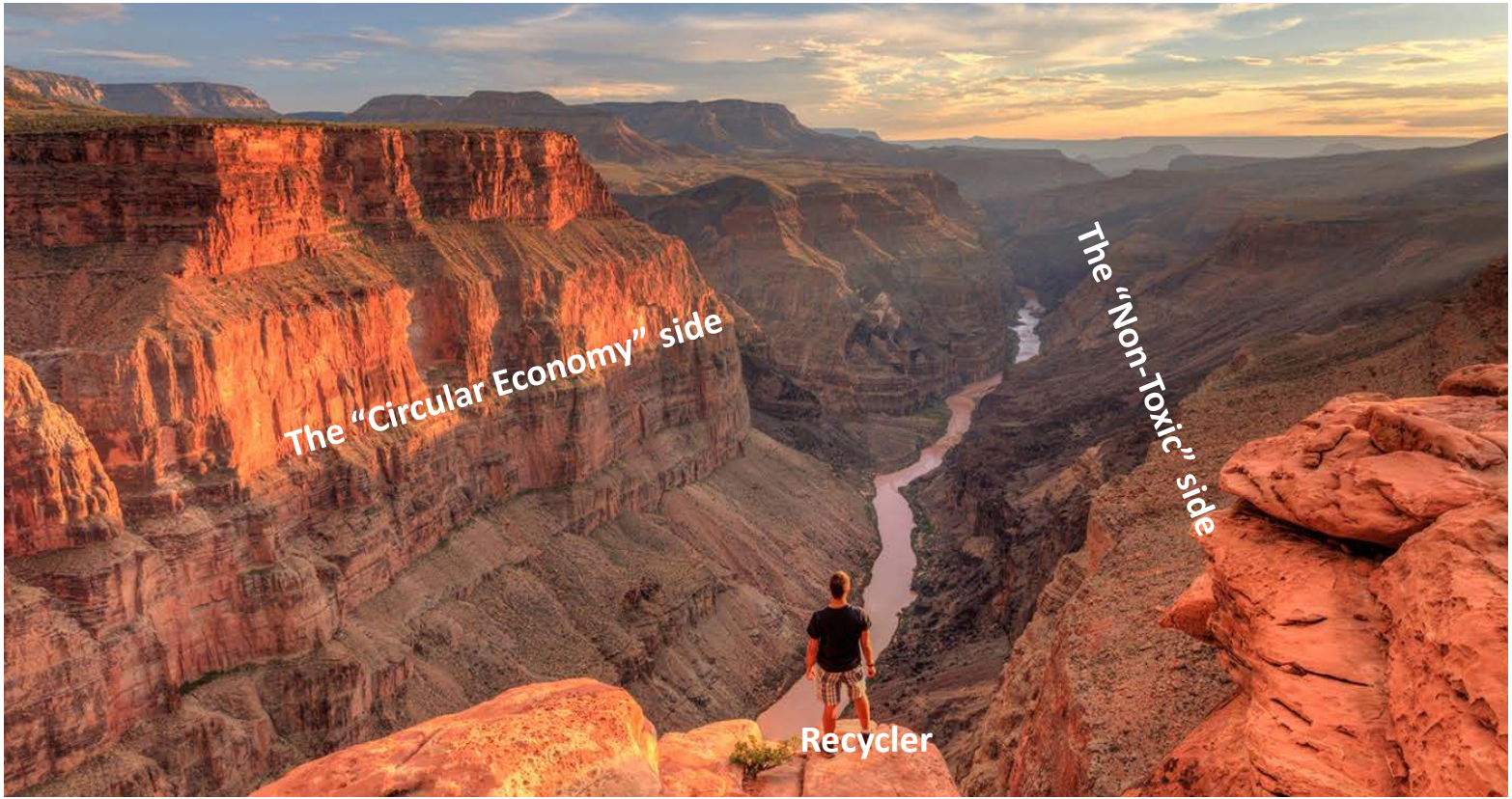
- **Differing interpretations on classification of plastics with BFR's in WSR**
  - Original only refers to PBB's, but a number of CA's decided to include other BFR's

- **Stockholm and Basel conventions COP May 2017**
  - POP-listing of deca-BDE (after penta-, octa-BDE, HBCD in previous years)
  - No thresholds fixed, but proposals of thresholds of as low as 10 or 50 ppm
  - 10 or 50 ppm would stop the recycling of WEEE plastics

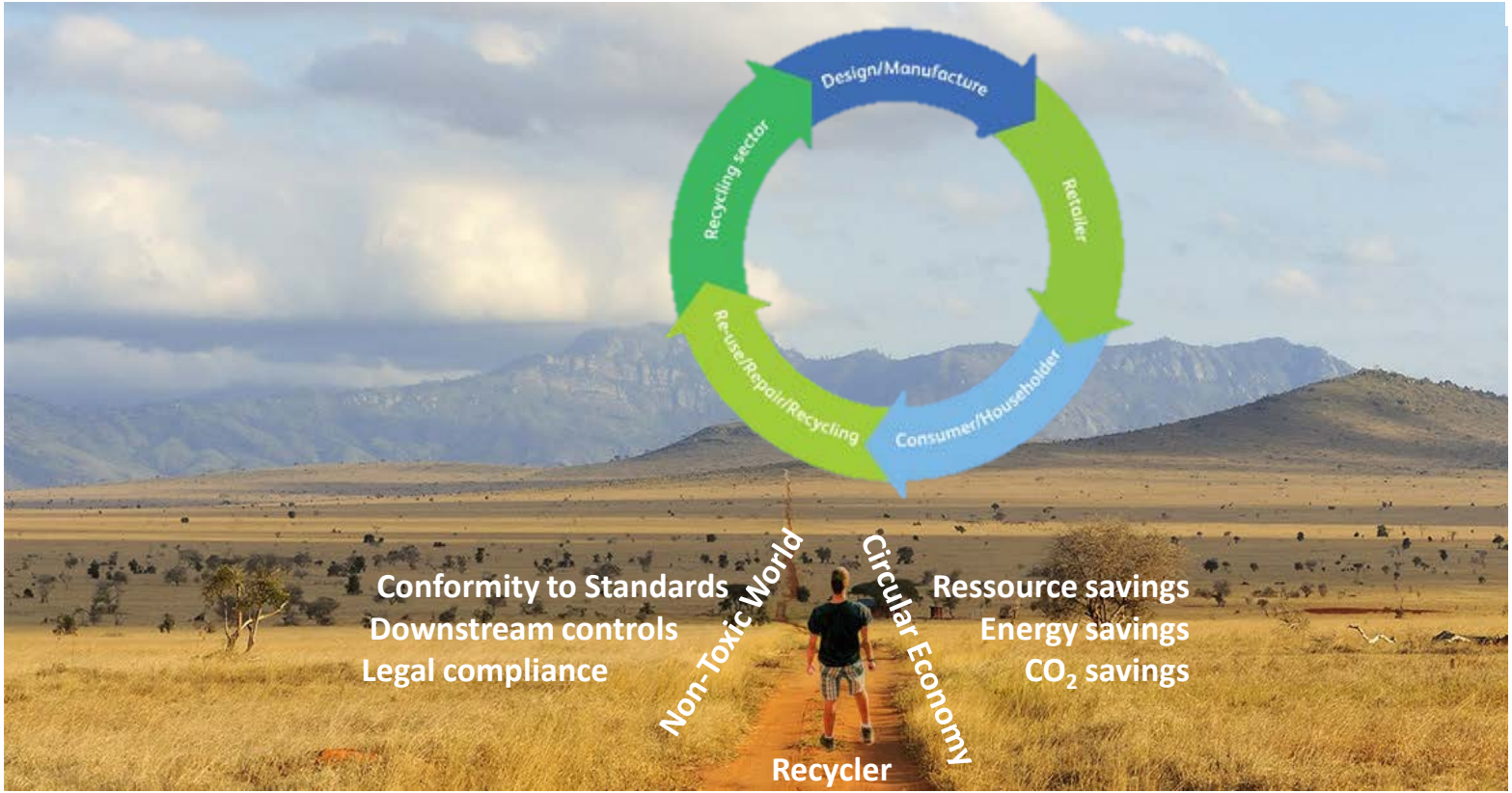
- **Discussion about this complexity is extremely difficult ….**

Ever continuing discussions since 2004 creating legal uncertainties

This is how it feels……..

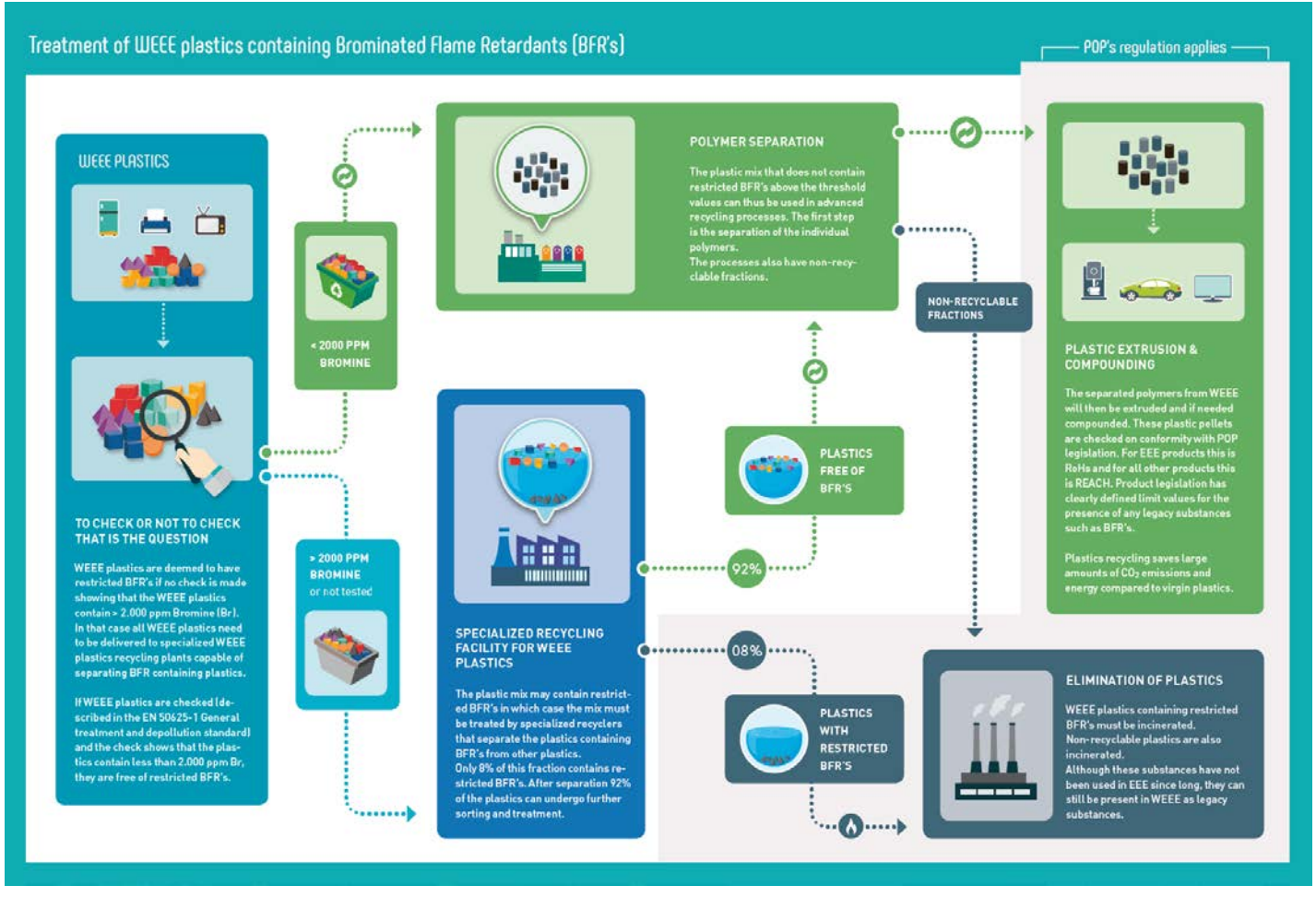


This is how we believe it should be……



intelligent balance between “Non-Toxic” and “Circular Economy”

An EERA Brochure of how it should be done…… separating BFRs



What is needed to keep on recycling and create a circular economy

Some legal certainty and clarity is required to stimulate this new recycling industry

A threshold for POP BFR Substances such as deca-BDE –> 1.000 ppm

- A threshold of 10 ppm is below the practical detection limit for deca-BDE for all practicle QM purposes
- To place this in a context: a flame retarded TV housing has 150 000 ppm
- Recycling requires analyses to be made on industrial scale (i.e. low cost XRF methods)
- These are validated for 1000 ppm

We need the recognition that POPs in WEEE plastics do not make then hazardous

- BFRs are firmly embedded in the polymer structure of the solid plastic
- No plastic recycling plant has a permit to accept hazardous wastes

We need a practical and simple procedures for transboundary transports

- Easier to obtain notifications
- Allowing pre-processed plastics to be transported to larger recycling facilties
- So that they can be properly recycled
- Right now too many BFR containing plastics are exported illegally

What is needed: an intelligent balanced approch for a “Circular Economy”

Why recycling of tech plastics from/for electronics

- **Without plastics recycling EU recycling targets impossible**
  - WEEE and ELV directives are clear in their targets
  - WEEE – 65 % for Small Domestic Appliances
  - ELV – 85 % as from 2015

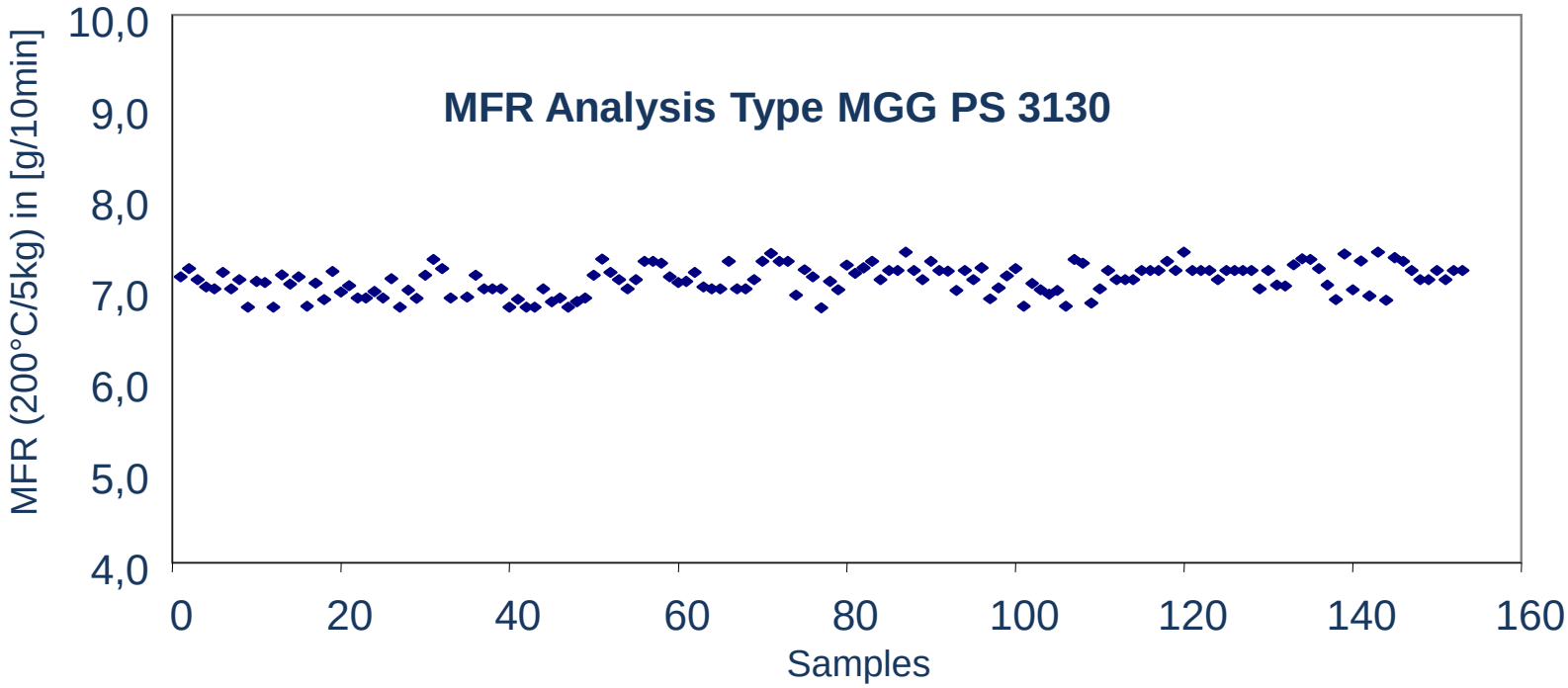
- **Increasing pressure from the market and environment**
  - Consumers increasinlgly become aware and look for „green products“
  - See: https://www.youtube.com/watch?v=4b9kNdzMv_o&t=112s
  - EU wants to develop a „recycling society“ and a „Circular Economy“
  - The EU plastics strategy

- **Replacing virgin plastics with recycled makes sense**

Plastics recycling... making plastics sustainable

PCR Recycled Products are becoming popular

Stable Properties are possible



RoHS and REACH Compliant Plastics

Some examples of recent green products

“Made with 55% recycled plastic, the Ultra Silencer Green from Electrolux is the most energy-efficient cleaner on the market. Its new, high-efficiency motor reduces the Ultra Silencer’s energy consumption by 33% compared to a standard 2,000 watt vacuum cleaner. Because Ultra Silencer Green is made out of recycled materials, it is only available in black, as this color allows to achieve the best looking finish and quality when using recycled materials. To signify Eco friendliness of the Green vacuum cleaner, Electrolux designers added signature elements of green on the graphics and buttons.”

SOURCE: Electrolux Pressrelease

Printer Cover and Components

Printer lid is made out of 100% PCR ABS

Product packaging advertises % recycled content

We have put our teeth in E-Waste plastics

and do not want to loose them...