

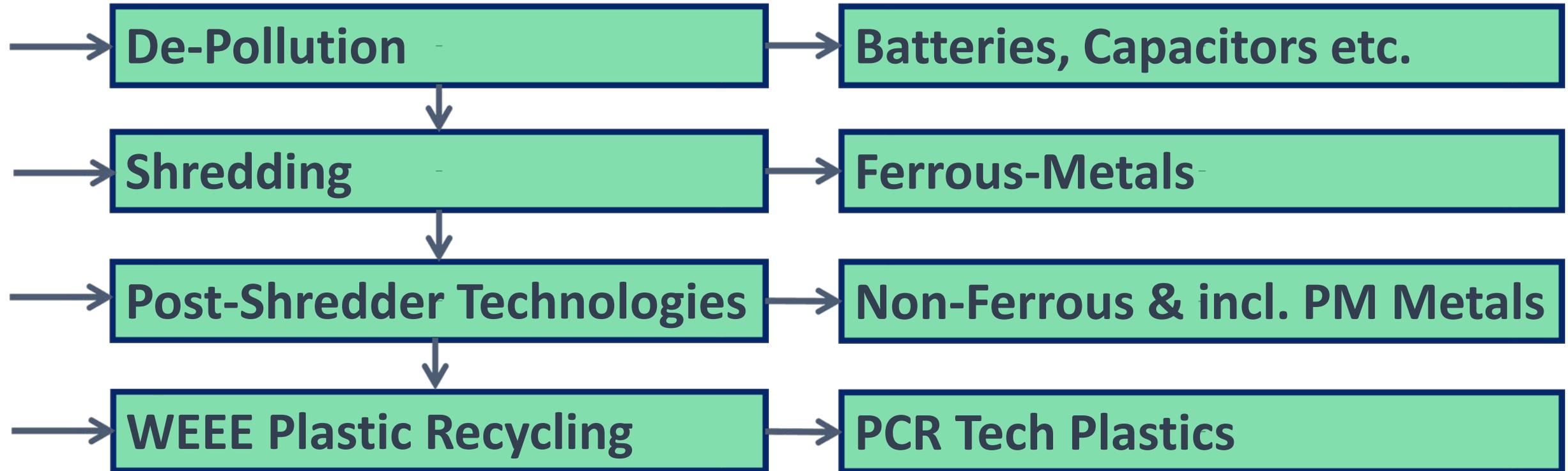
E-Waste plastics recycling and its challenges.....



Presentation study
Impacts of BFRs on the Recycling of WEEE plastics in Europe
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Plastic Recycling from WEEE



WEEE Plastics are the last remaining fraction to be treated

Here is an example of a WEEE Plastics Recycling facility



► Goods-In and Pre-processing

- Each receipt is sampled and analyzed
- Material cleaned from non-plastics



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▶ High-tech plastic separation

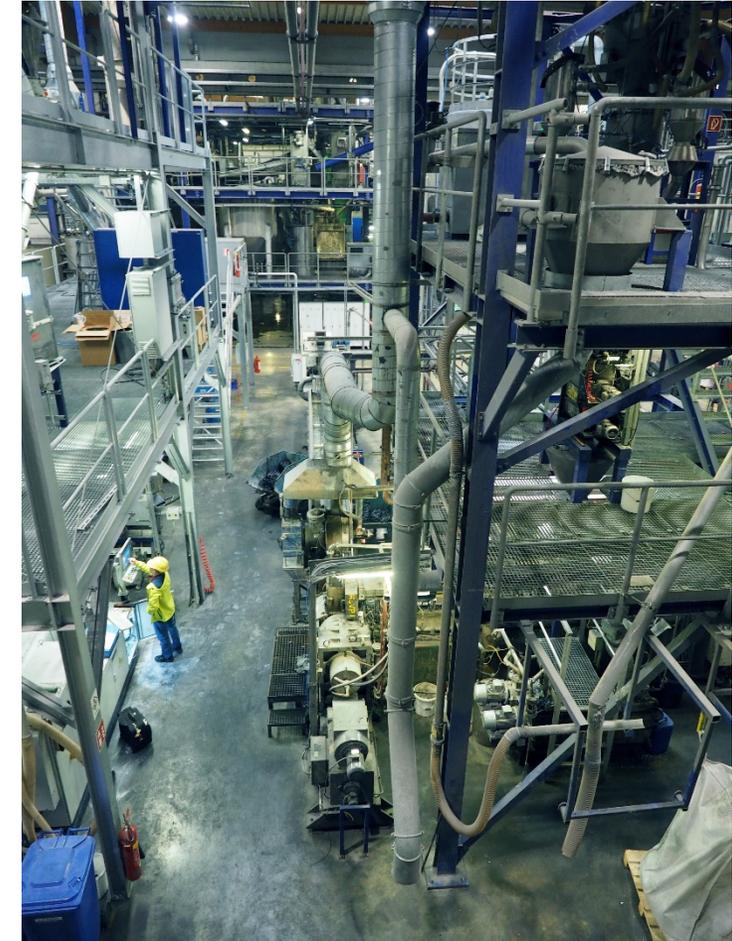
- Cleaning and separations
- PP, HIPS, ABS and PC-ABS



Here is an example of a WEEE Plastics Recycling facility



- ▶ **Goods-In and Pre-processing**
 - Each receipt is sampled and analyzed
 - Material cleaned from non-plastics
- ▶ **High-tech plastic separation**
 - Cleaning and separations
 - PP, HIPS, ABS and PC-ABS
- ▶ **Blending, Extrusion and Compounding**



Here is an example of a WEEE Plastics Recycling facility

Waste

- ▶ **Goods-In and Pre-processing**
 - Each receipt is sampled and analyzed
 - Material cleaned from non-plastics
- ▶ **High-tech plastic separation**
 - Cleaning and separations
 - PP, HIPS, ABS and PC-ABS



Product

- ▶ **Blending, Extrusion and Compounding**
- ▶ **Lab Analyses Physical, Chemical (REACH/RoHS/POP) & Rheologic**

Output Material are PCR polymers, used as drop-in replacement for virgin

Some examples of products with 100% PCR Plastics



Post-Consumer Recycled Plastics (PCR Plastics)

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



The production of PCR tech-polymers



Procurement



- ▶ WEEE (E-Waste) plastics
- ▶ Growing supply
- ▶ Produced by WEEE recyclers
- ▶ All from EU sources

Processing



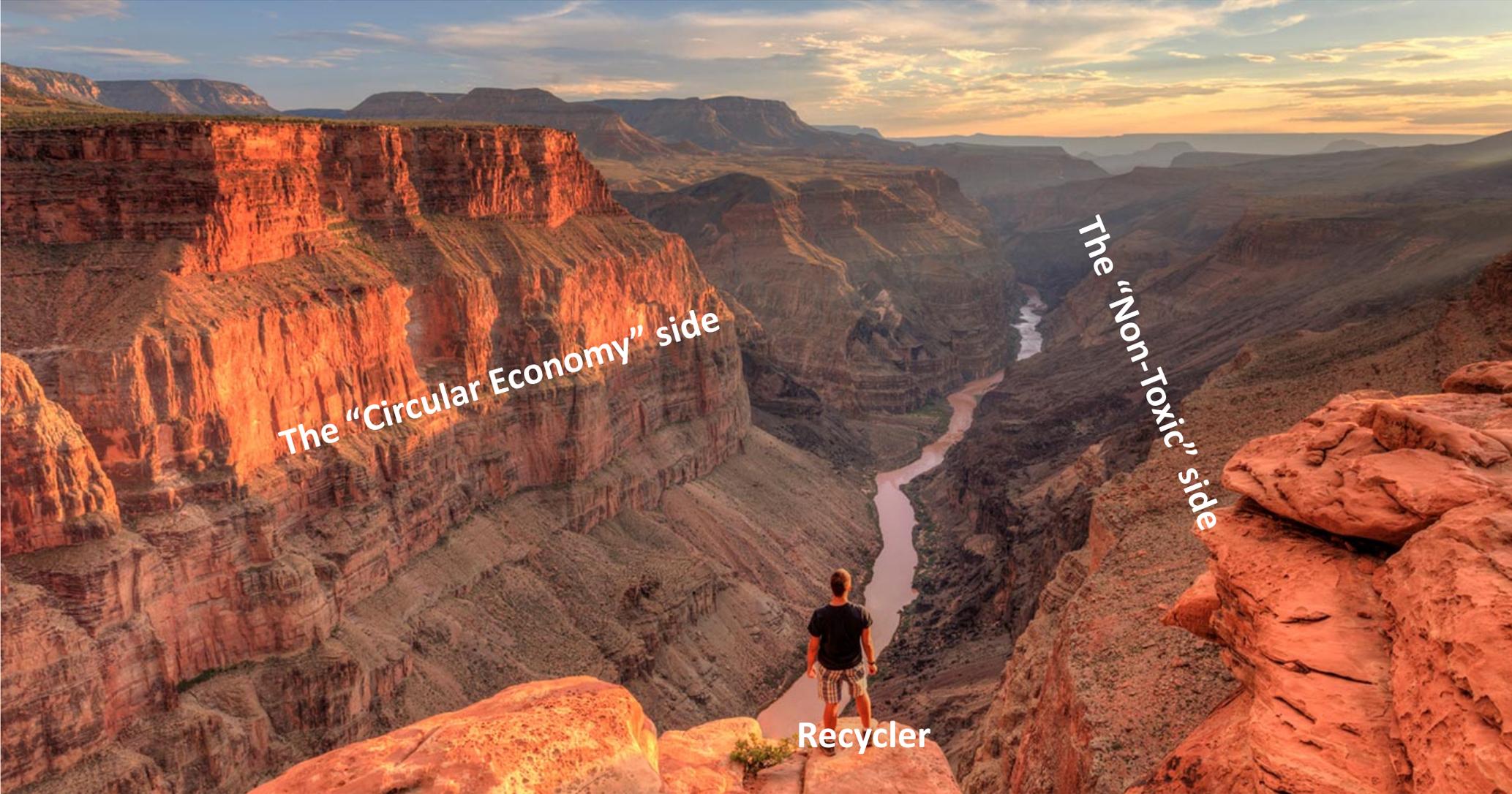
- ▶ Mechanical 'mining' process
- ▶ Innovative technologies
- ▶ < 10% of energy
- ▶ Save about 3-5 tons CO₂/ton PCR

Selling



- ▶ 100% PCR tech-polymers
- ▶ Virgin-like quality
- ▶ Stable prices
- ▶ For "green" sustainable products

A recyclers' view on policies.....



A brief (incomplete) overview over time



- ▶ **WEEE Directive – 2004** -> Annex II — plastic containing brominated flame retardants

Recycling process built upon TAC Guidance

“Substances, preparations and components may be removed manually, mechanically or chemically, metallurgically with the result that hazardous substances, preparations, and components and those mentioned in Annex II are contained as an identifiable stream or identifiable part of a stream at the end of the treatment process. A substance, preparation or component is identifiable if it can be (is) monitored to prove environmentally safe treatment.”

This is pragmatic and practical guidance....

A brief (incomplete) overview over time



- ▶ **WEEE Directive – 2004** -> Annex II — plastic containing brominated flame retardants
- ▶ **RoHS 1 – 2005** -> PBDE's but Deca-BDE was taken with a threshold of 1000 ppm
- ▶ **Waste Shipment Regulation 2006** -> A3180 PBB 50 ppm (!)
- ▶ **REACH 2007** -> allegedly replacing all other chemical legislations – impact on PCR plastics.
- ▶ **RoHS – 2008** -> Addition Deca-BDE 1000 ppm
- ▶ **Basel/Stockholm Convention 2008** -> POP listing Octa-and Penta-BDE 1000 ppm
- ▶ **Stockholm Convention 2017** -> Listing Deca-BDE as POP
- ▶ **POP Regulation review 2018** -> EU Parliament Decision 10 ppm for Deca-BDE -> panic in the industry
- ▶ **POP Regulation publication June 2019** -> Finally Trilogue resulted in 1000 ppm for PBDE's (Feb 2019)
- ▶ **RoHS Review 2019-2020** -> Study proposing TBBPA and Antimony – ongoing discussion
- ▶ **COP BRS 2021** -> major discussions about thresholds and new EU study to reduce further - ongoing

Legislation overview Brominated Flame Retardants



EEE Products

IT electronics

(microprocessors, computer servers, modems, printers, copy machines...)

Consumer electronics

(hair dryers, heaters, TV sets, laptops...)

White goods

(tumble dryers, dishwashers, washing machines...)

Plastic Parts

Housing

Printed circuit boards

Cables

Connectors

HBCD

DecaBDE³

c-PentaBDE

c-OctaBDE

BDP

RDP

TBBPA

DOPO

EBP

ATH

MDH

ATO

Br'd PS

Mel.Cyanurate

Regulations

Annex XIV

POP Regulation

Restriction under RoHS

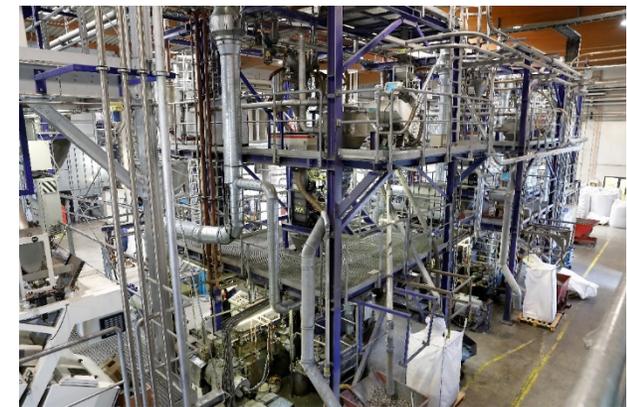
Restriction under REACH

No restriction

Some thoughts about a reduction of thresholds



- ▶ The latest POP Regulation review was published June 2019 !
- ▶ The screening technique is based upon XRF screening ([link EERA input Guidance Document](#))
 - Based upon a validated test threshold of min. 1000 ppm of bromine (EN 62321-3-1)
 - Measuring bromine does not give insight anymore into the restricted BFRs
 - Most BFRs that we measure are allowed substances
 - However certain WEEE fractions still have a lot of PBDEs (CRT's, Copiers/Laserprinters)
 - Therefore a Low POP Content below 1000 ppm level is a problem
 - For PCR plastics the EN-62321-3-1 can be safely used
 - The material is homogenized by blending and extrusion
 - Hence this results in „averages“ of BFR substances
 - And this is why a UTC of 500 ppm for PBDEs is possible (statistically)
 - But not lower than this value.



And...what is the value of the Low POP Content, if there is no need to measure?

Most effective way of reducing restricted BFRs?



- ▶ **Not adding substances to new products results in a phase out** (happening since 2004)
- ▶ **Making sure that all WEEE is collected and treated in line with the standards**
 - So that compliant plastics recyclers produce REACH, RoHS, POP compliant PCR plastics
 - Incinerating the non-recyclable content, thus eliminating the POP BFRs
- ▶ **Promote the development of more WEEE Plastics recycling capacities in the EU**
 - So making sure that there is legal certainty for investors to invest in this industry is important
 - Having (and changing) BFR thresholds in so many legislations does not help
 - TBBPA is a next area of uncertainty and concern
- ▶ **Prevent the inclusion of regrettable substitutions**
 - Other FR types might turn out to be a problem to this industry
 - Failing known separation techniques and quality concerns of PCR material



WEEE Plastics Recycling needs a minimum of legal clarity/stability in order to grow

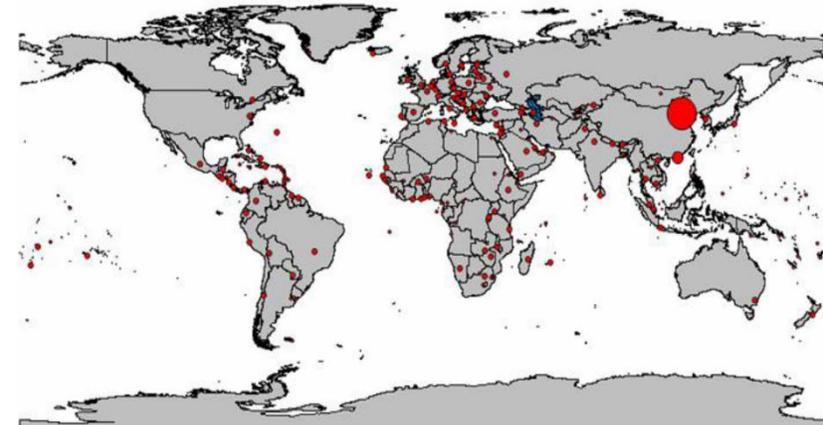
The windy roads of plastics....moving our WEEE plastics



The western Africa route



The China route



For a long time exports resulted in losses of well over 1 Mio MT from the EU Urban WEEE Mine

Delegated Act “Norwegian proposals”

▶ Separated clean plastics

- Green listed waste without notification
- Under Basel Code B3011 and EU3011

▶ Mixed non separated plastics

- Requires prior consent (Notification Procedure)
- “Amber”-listed – non-hazardous waste
- Under Code Basel Y48 or EU48
- Required already for WEEE plastics (guidance is failing still)

▶ Contaminated plastic waste

- Requires prior consent (Notification Procedure)
- Basel: “Red-listed” – hazardous waste (EU also??)
- Under code A3210 or in EU AC300
- Hazardous results in much higher costs for
 - Transport
 - Incineration



To be implemented on Jan 1st 2021, but not yet officially published

Plastics in the linear world can move freely.

- ▶ WEEE plastics cannot move freely in Europe
- ▶ WEEE plastics with BFRs **cannot** be imported from France, UK and parts of Germany
- ▶ Notifications can take up to 4 years
- ▶ In 2 months this „Delegated Act“ plastics will be law
- ▶ But still there is no publication of the „Delegated Act“
- ▶ Nor is there clear guidance in sight
- ▶ And then we have the WSR review process



WEEE plastics are raw materials, that should be able to be moved to recycling plants....

Final remarks



▶ **The technology is available, so everything is in place for the Circular Economy**

▶ **An enormous amount of hurdles for this industry to develop further capacities**

- Continuous changing thresholds
- Many years the „plastics roads were windy“ (Far-East)
- Although in the EU we face problems sourcing from some EU countries
- „Norwegian Proposals“ – lacking publication and guidance



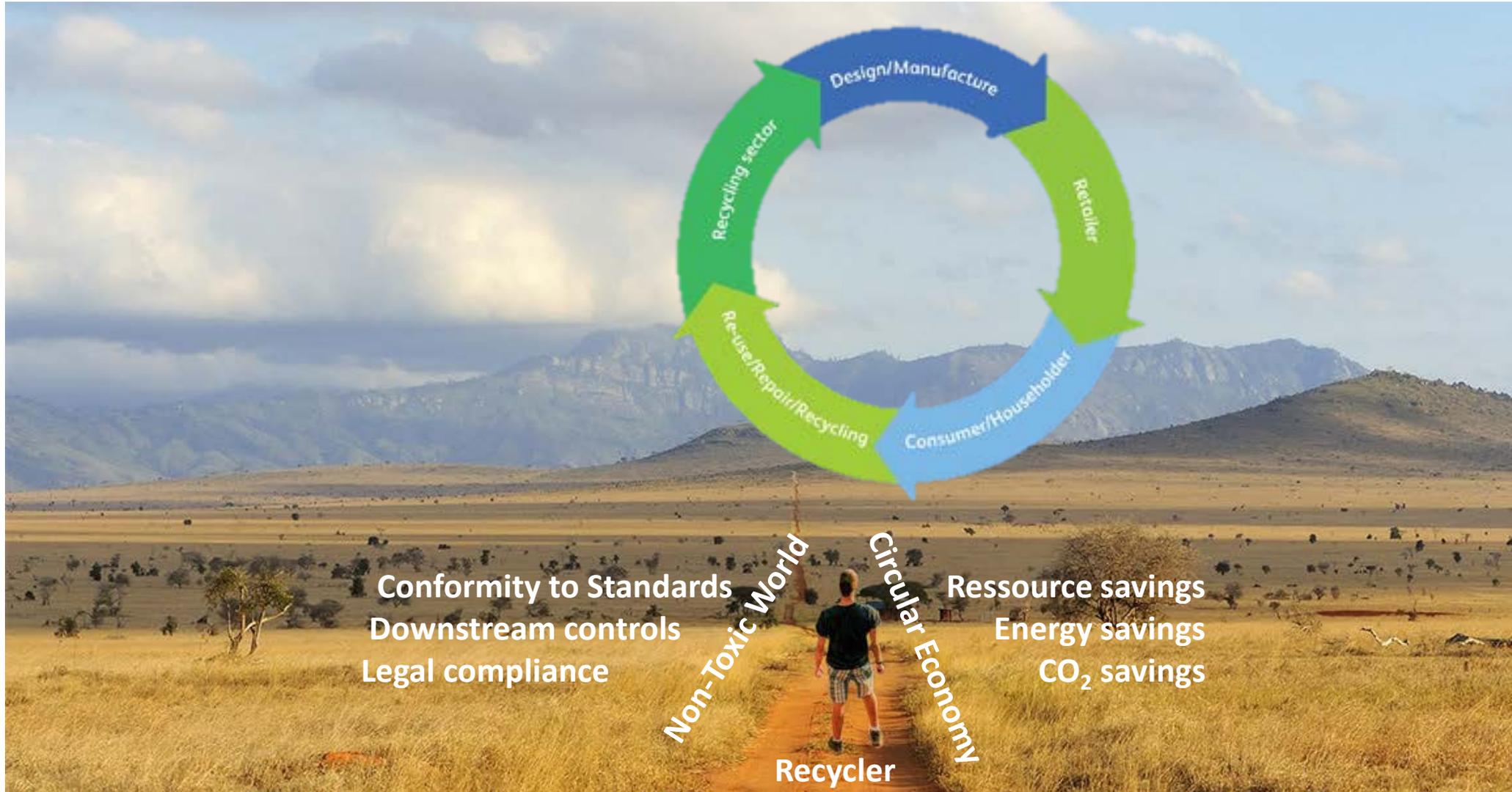
▶ **WEEE plastics recyclers operate under both Waste and Product legislations**

- PBDE's – RoHS, REACH, Basel, Stockholm, POPs, Waste Shipment Regulation
- RoHS review (ATO & TBBPA) – proposed new restriction of TBBPA? Why RoHS and not REACH?
- New Study on POP thresholds – particularly interesting regarding PBDE's and HBCDD's (next year COP).

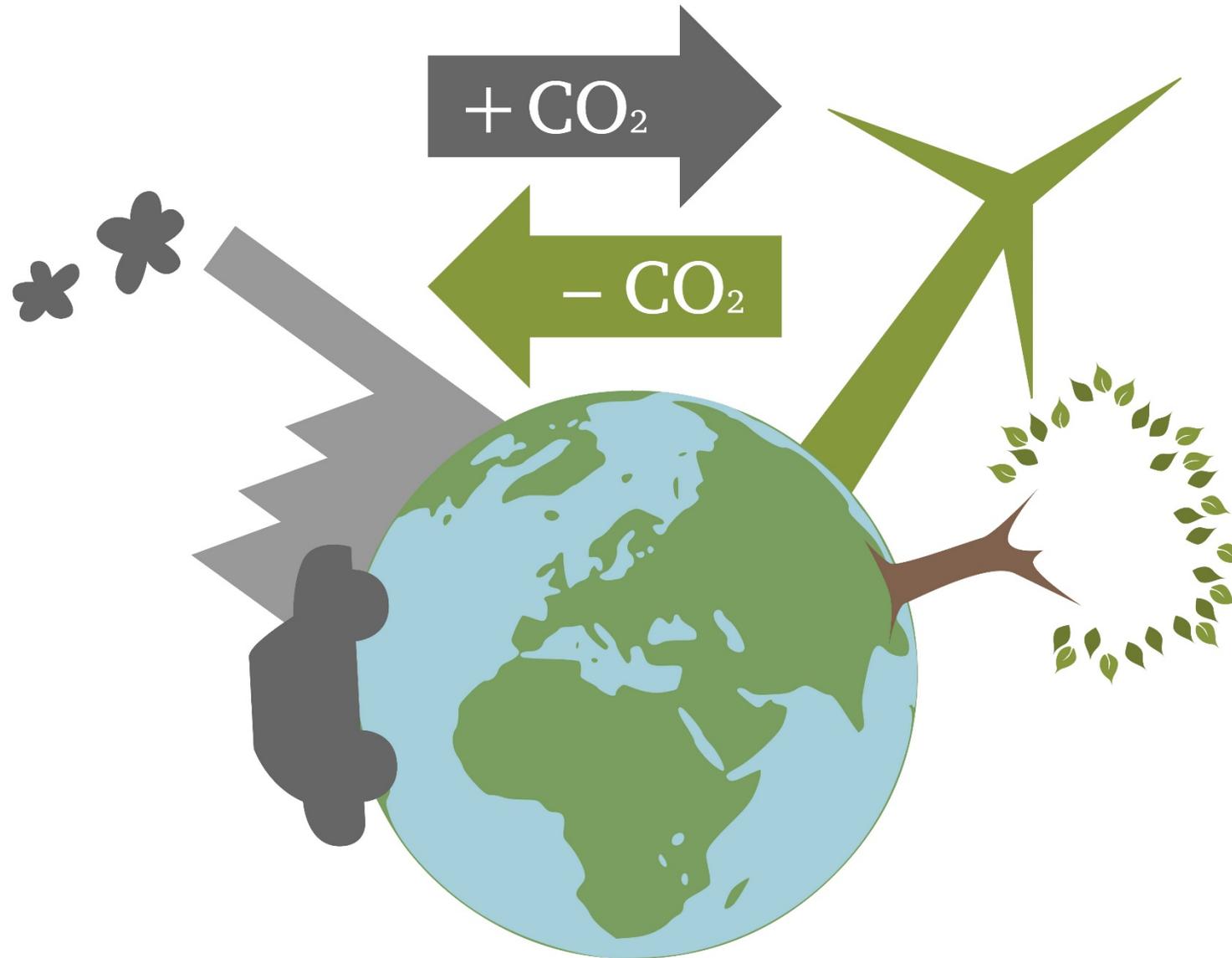
▶ **And all this in difficult market circumstances (COVID, oil prices)**

WEEE Plastics recycling: a fantastic carbon footprint with huge energy savings

Let's please strike the right and intelligent balance.....



between “Non-Toxic” and “Circular Economy” objectives



WEEE plastic recycling; we absolutely need more of it...

