Hazardous elements in plastic and glass articles for food contact and storage

Andrew Turner

SoGEES

University of Plymouth

Plymouth PL4 8AA

aturner@Plymouth.ac.uk

ENVIRONMENTAL SCIENCE WITH PLYMOUTH UNIVERSITY

Presentation outline

- Plastic additives
- Regulations for hazardous chemicals in plastics
- Source of hazardous chemicals in plastics
- Examples of contaminated food contact plastics
- Hazardous chemicals in glass
- Shortfalls of regulations

Plastic additives

- Anti-counterfeiting
- Anti-microbials
- Anti-oxidants
- Antistatic agents
- Blowing agents
- Fillers
- Impact modifiers

- **Flame retardants**
- **Heat stabilisers**
- **Pigments**
- **Plasticisers**

Regulations for hazardous chemicals in plastics

- **RoHS Directive** (2006)
- **IEEE Standard** (2006)
- **EU** (2011)
- **Directive 94/62/EC** (1994)
- **Toy Safety Directive** (2009)
- **Regulation 494/2011** (2011)
- **Directive 2002/72/EC** (2002)

Cd, Pb, Cr(VI), Hg, BFRs in electronic plastic

Cd, Pb, Cr(VI), BFRs in computers

Cd, Pb, Cr(VI), Hg in consumer goods

Cd, Pb, Cr(VI), Hg in packaging/packaging waste

Cd, Pb, Cr(VI), Hg in plastic toys

Cd, Pb in plastic jewellery

Pb, Cr(VI) in food contact articles

- **Packaging: Cd, Pb, Cr(VI), Hg = 100 $\mu g\ g^{-1}$**
- **Food contact: Pb = 2 $\mu g\ g^{-1}$; Cr(VI) = 1 $\mu g\ g^{-1}$**

EU RoHS Directive effective 1/7/2006

Restrictions on the use of Hazardous Substances in Electrical and Electronic Equipment (EEE)

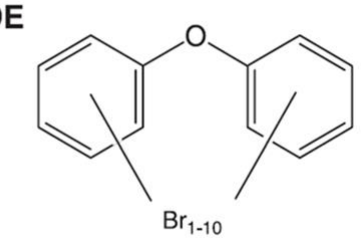
RoHS compliance limits:

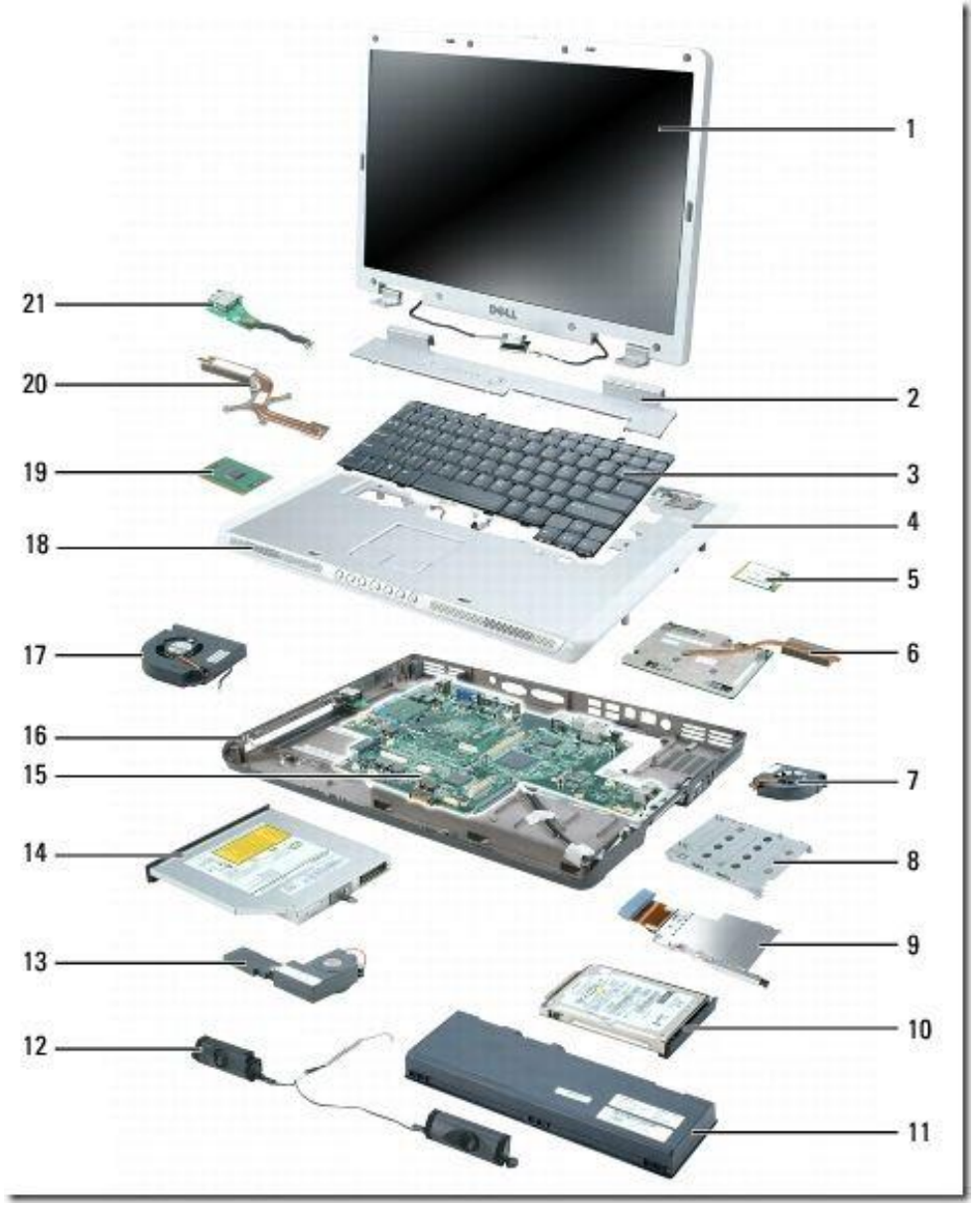
Br as certain BFRs = 1000 μg g^{-1}

Cd = 100 μg g^{-1}

Pb, Cr(VI), Hg = 1000 μg g^{-1}

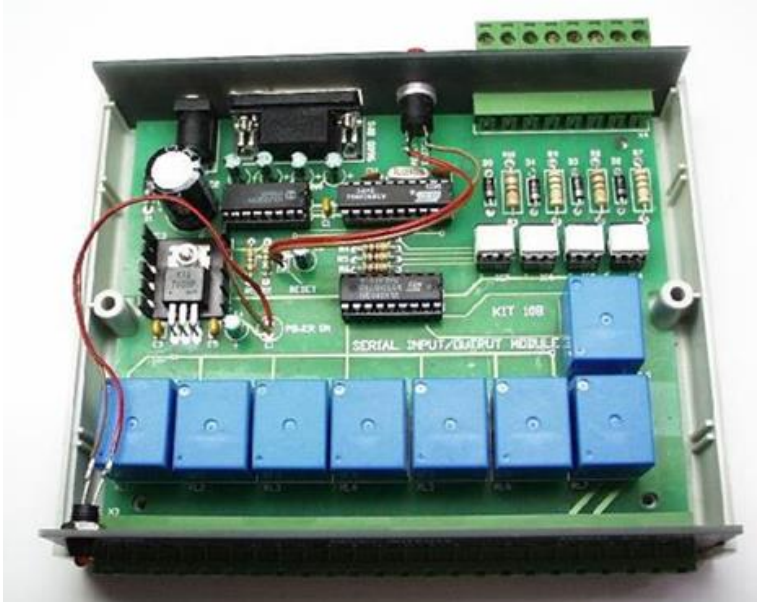
PBDE





Additives in electronic plastic:

Br - BFRs

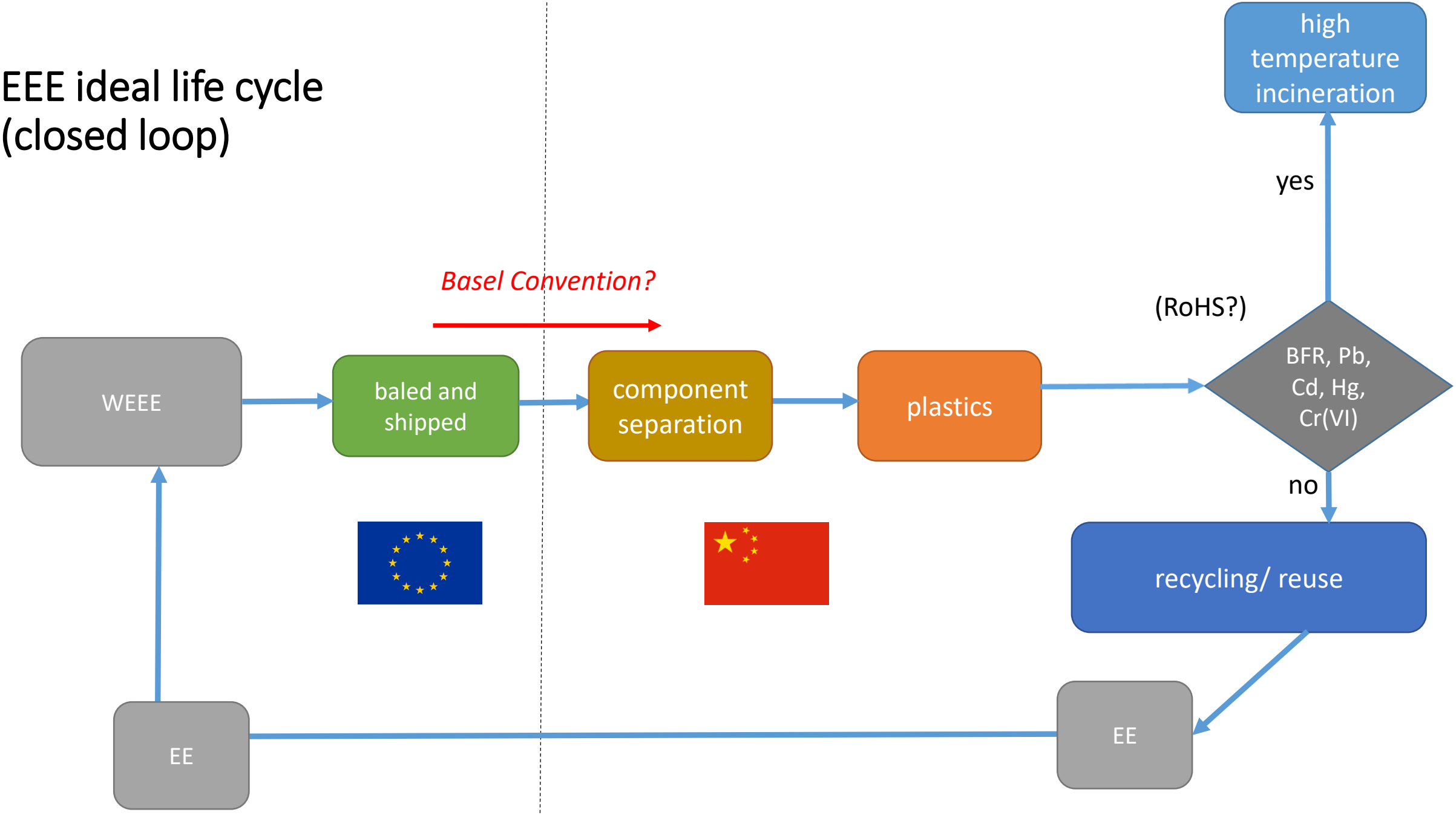


Impurities in electronic plastic:

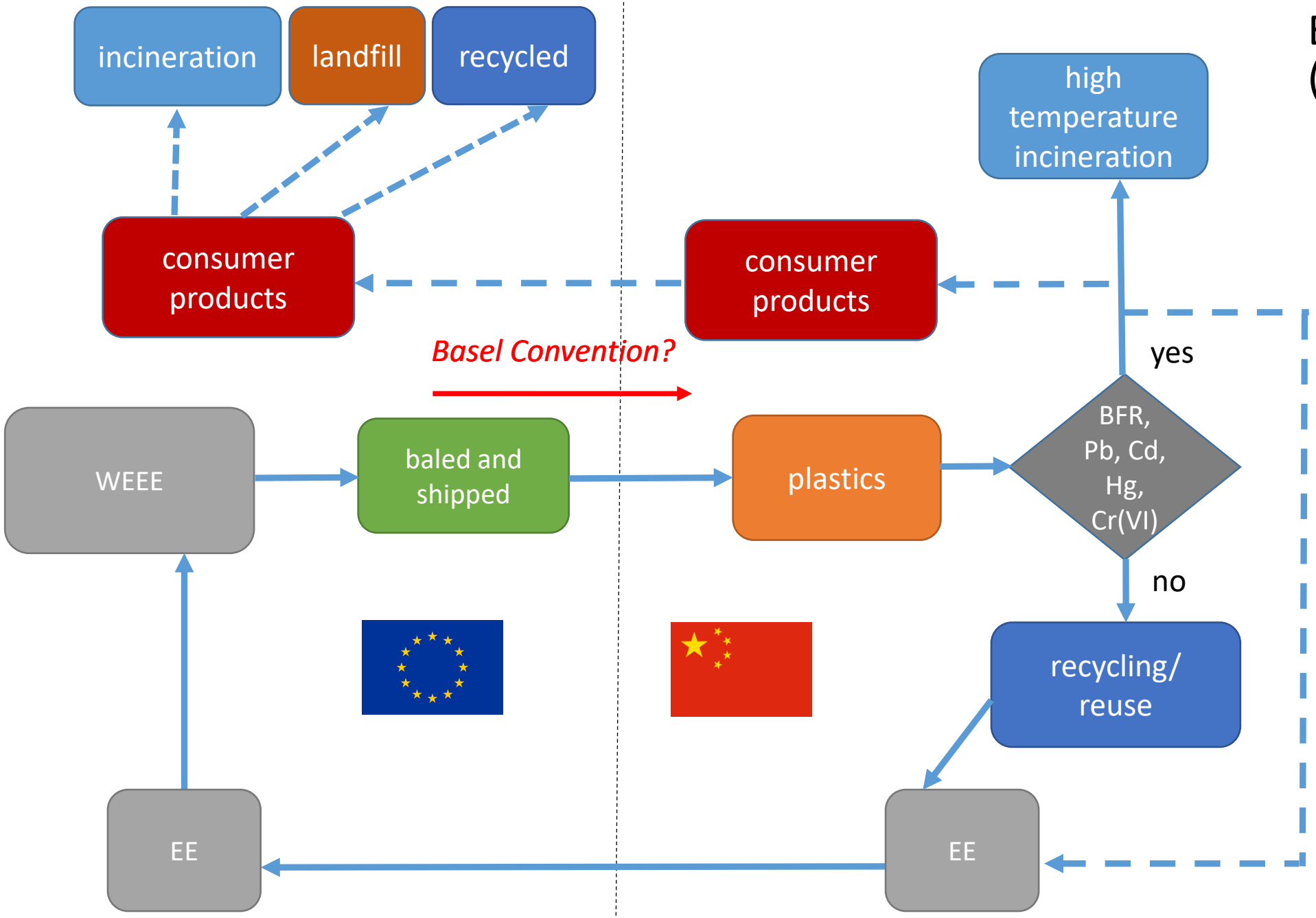
Pb – CRTs, solder, stabiliser for PVC

Cd – semiconductors, pigment in inks and paints

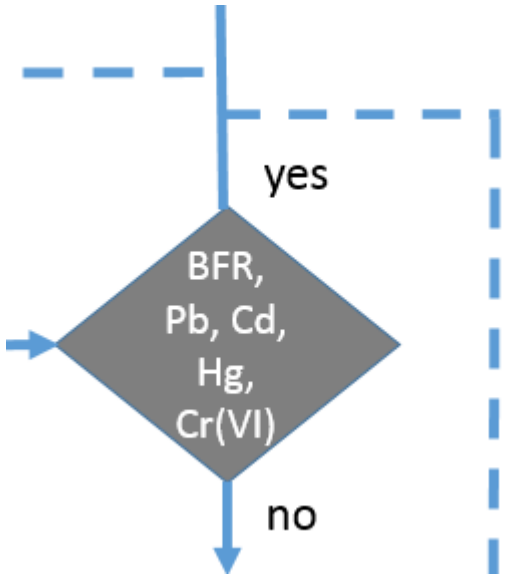
EEE ideal life cycle (closed loop)



EEE life cycle (open loop)



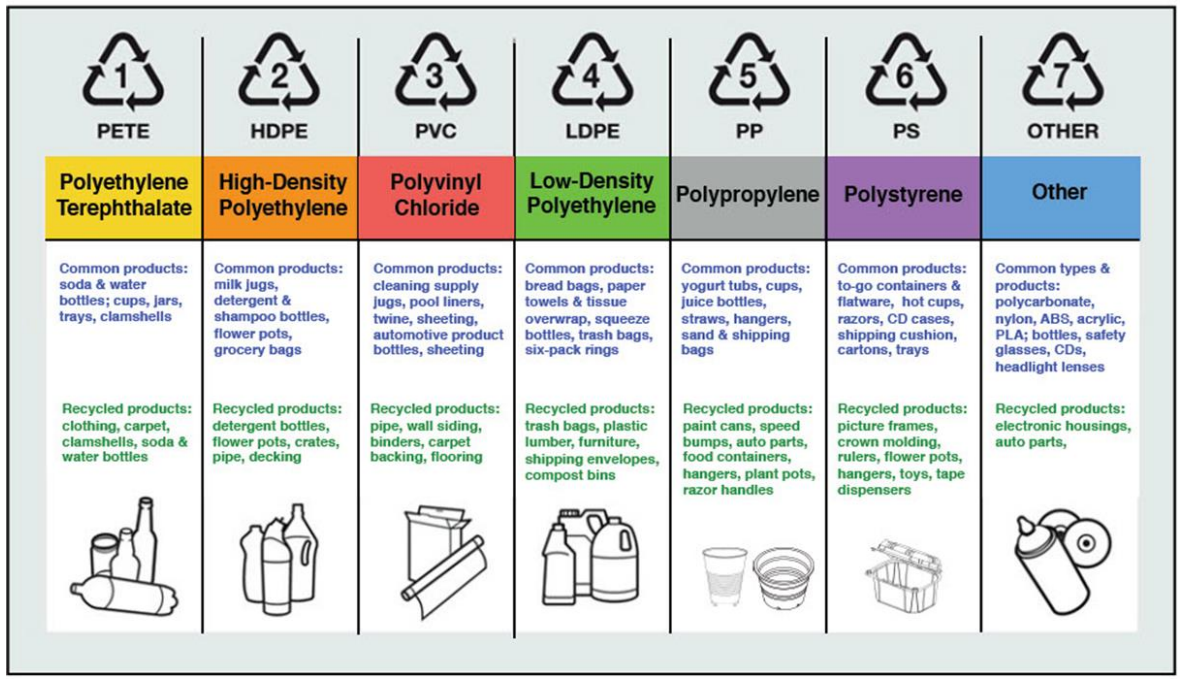
- Snip or burn/melt wires for Cu retrieval
- Wrench components from circuit boards
- Grind plastic
- Dissolve metals in HNO_3 or HCl
- Uncontrolled burning



Consequence:

Hazardous chemicals imported in consumer products (mainly “black”)

Infra-red sorters cannot detect black



resource

Sharing knowledge to promote waste as a resource

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THE ONE SHOW TACKLES BLACK PLASTIC CONFUSION

By Katy Carter | 15 March 2017 | Add a Comment

PRINT E-MAIL SHARE

On Monday (13 March), BBC’s *The One Show* highlighted the confusion surrounding black plastics recycling and what is being done about it, shedding some light on the current situation, and interviewing representatives of a partnership between plastic consultancy Nextek and Viridor that is aiming to address the problem.

Each year, over 1.3 billion black CPET trays are used in packaging in the UK and, despite being technically fully recyclable, it is not currently possible to effectively sort them from other materials at a materials recovery or plastic recycling facility and so the trays often get sent to landfill or incineration. The reason for this is that the main pigment used to colour black plastic, carbon black, is not detectable by the near-infrared (NIR) optical sorting equipment, because it does not allow the light to pass through.


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Portable XRF spectrometry

Some matrix effects/interferences

Cannot discriminate Cr (III) / Cr (VI)

Cannot determine type of BFR from Br

PE, PP, PS, ABS


Pb, µg g-1
10-11 YRS
9.2
<6.0
45.9
8.1
49.9
5.9


Cd, µg g-1
10-11 YRS
<23
<23
44.1
148
81.8
53.1
<28


Br, µg g-1
501
17.5
5.6
< 5.0
6010
1230

Compliance with regulations

- **Directive 94/62/EC** (1994)
- **Directive 2002/72/EC** (2002)

- **RoHS Directive** (2006)

2 non-compliant (Pb + Cd > 100 μg g^{-1})

>5 non-compliant (Pb > 2 μg g^{-1})

2 potentially non-compliant (Br > 1000)

BFRs not regulated in food contact articles


Pb, Cd, Br
never
detected
in PET

Decorated glassware for food and drink

Cd = 19,400 µg g^{-1}
(heat resistant pigment)

Pb = 46,500 µg g^{-1}
(overglaze)

Regulations for hazardous chemicals in plastics

RoHS Directive (2006)	Cd, Pb, Cr(VI), Hg, BFRs in electronic plastic
IEEE Standard (2006)	Cd, Pb, Cr(VI), BFRs in computers
EU (2011)	Cd, Pb, Cr(VI), Hg in consumer goods
Directive 94/62/EC (1994)	**Cd, Pb, Cr(VI), Hg in packaging/packaging waste**
Toy Safety Directive (2009)	Cd, Pb, Cr(VI), Hg, Sb in plastic toys
Regulation 494/2011 (2011)	Cd, Pb in plastic jewellery
Directive 2002/72/EC (2002)	**Pb, Cr(VI) in food contact articles**

- **Packaging: Cd, Pb, Cr(VI), Hg = 100 $\mu g\ g^{-1}$**
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Is the décor a separate component of the container?

Cd = 6900 μg g^{-1}
(unglazed pigment)

Cd when total mass accounted for ~ 50 μg g^{-1}

Human health risk and contamination of glass cullet

Conclusions and recommendations

- Recycled WEEE plastic appears to be the main source of hazardous contaminant in food contact plastics
- Largely limited to black plastics (non-PET)
- Cadmium and lead are <u>deliberately</u> added to glass containers for décor
- Regulations are needed to address:

(i) Export of hazardous plastics

(ii) Recycling of materials into products serving a different function

(iii) Components of articles that pose a hazard