The POP separation process in the recycling of WEEE.

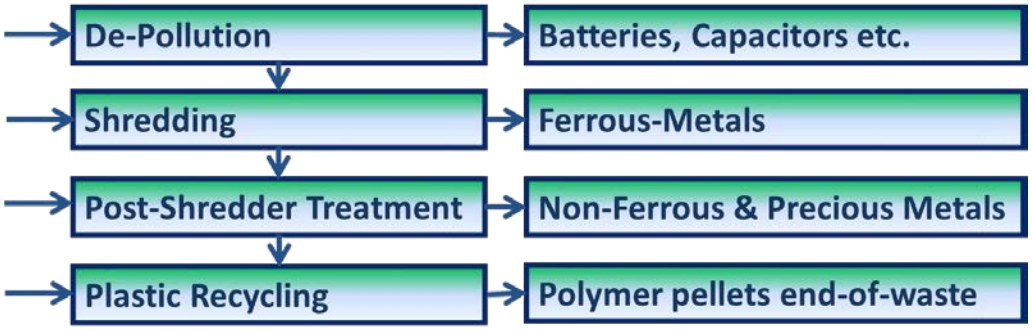
Notes and recommendations about the current recast proposals for a UTC threshold value for Deca-BDE

The recycling process of E-Waste and its plastic fraction.

The recycling process of Waste from Electrical and Electronic Equipment (WEEE) is developed on the basis of this definition by the European Union:

"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 has resulted in a recycling process with the following steps:



The plastic recycling process takes place at the end of the recycling processes of WEEE. The result of these recycling processes is on the one hand REACH and/or RoHS compliant Post-Consumer Recycled plastics that have reached End-of-Waste status and a fraction of non-recycled plastics, which include the plastics with brominated flame retardants containing both brominated flame retardants (BFRs) that can still be used and those containing restricted BFRs. In Europe the latter fraction is incinerated and by this incineration process the POP content is destructed.

This implies that the plastics from E-Waste might contain POPs over and above POP LPC levels, as long as these are delivered to recycling plants separating these POP containing plastics.

It is after this plastic recycling process that the plastic waste fraction with a "high" POP content (i.e. above the LPC) is *"disposed of in such a way that the POP content is destroyed or irreversibly transformed so that they do not exhibit the characteristics of POPs or otherwise disposed of in an environmentally sound manner when destruction or irreversible transformation does not represent the environmentally preferable option or the POP content is low.*

The recycled plastics that are placed on the market need to comply with the UTC (Unintended Trace Contaminants) threshold set by the EU POP Regulation. The currently proposed UTC

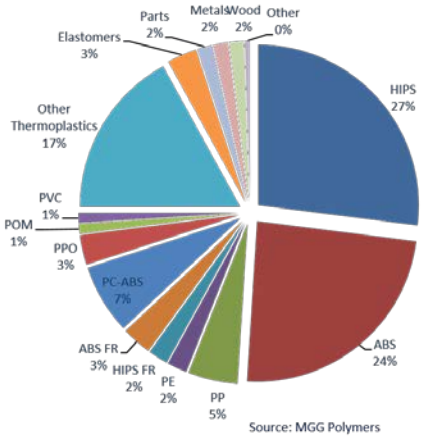
threshold for one of the most frequent used flame retardants Deca-BDE is 10 ppm. This is 100 times lower then the REACH threshold agreed only one year ago of 1000 ppm by the European Union and this was considered to be safe for the public health and the environment.

Where the 1000 ppm threshold can just about be matched by the WEEE plastics recyclers in the EU, a 10 ppm threshold would stop the recycling of WEEE plastics immediately.

Plastics from WEEE and the content of POP BFR's.

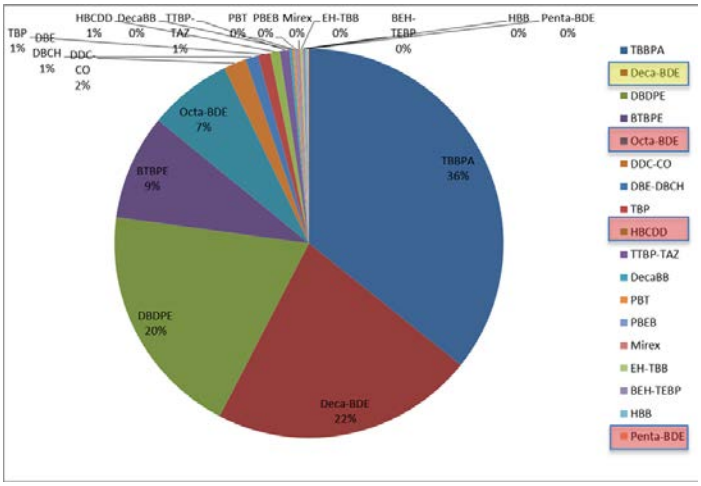
The mix of plastics in WEEE is a highly complex mix of high valuable technical plastics.
The composition of this mix consists of some 65 % of recyclable content, mainly Styrenics (ABS and HIPS, Polyolefin (mainly PP) and PC and PC-ABS. The remainder of this solid plastic waste fraction consists of a wide variety of plastics that to date are not recycled. These plastics include the solid plastics with brominated flame retardants. In the average mix of solid plastics wastes coming out of the WEEE recycling processes, typically 5 – 10 % consist of plastics with flame retardants (see Graph below).

ABS	24%
HIPS	27%
Polyolefines	7%
PC and PC-ABS	7%
Solid Plastics with BFR's	5%
Other plastics	24%
Parts and metals	4%
Other (mainly wood)	2%



Source: MGG Polymers

Of the fraction that contains BFRs, the POPs with defined threshold values (octa- and penta-BDE and HBCDD) represent not even 10% of the plastics containing flame retardants and this can be explained by the fact that these have been phased out since Deca-BDE replaced these substances. Deca-BDE in turn has been phased out in electronic appliances with the introduction of the RoHS directive in 2004, which explains that we have seen large reductions over the last couple of years. Deca-BDE represented some 22% of the BFRs in WEEE plastics in 2011 still decreasing (see also study "Stoffflüsse im Schweitzer Elektronikschrott". www.bafu.admin.ch/uz-1717-d



The environmental Aspects of Recycling of WEEE plastics.

The environmental benefits of the recycling of solid plastics wastes from durable products such as WEEE are impressive. This is a logic consequence of the production chain of virgin plastics, which starts with the extraction of crude oil, which subsequently is transported to refineries and these refineries produce monomers, which are subsequently "knitted" together in long polymer chains by large plastic manufacturers.

The recycling of plastics keeps all this energy input in the polymer chains, which are basically re-used after the separation and recycling processes. EMPA has performed two Life-Cycle Analyses comparing the recycling process of a major EU WEEE plastic recycling plant to the production of virgin plastics and one other one comparing the recycling process to the incineration of this plastics mix.

The result of this Life Cycle Analysis is that the recycling process is clearly superior to the alternatives considered in this study from an environmental perspective, both with regard to the performance of post-consumer recycled plastics and the performance of the recovery and disposal routes for plastics-rich shredder residues originating from dismantling / mechanical processing of WEEE. Large amounts of CO_2 emissions are prevented (some 3-4 MT of CO_2 emission savings per MT of recycled plastics) and energy savings (some 90% versus virgin) are the result of plastic recycling. From a global warming and climate point of view the recycling of these plastics should be supported, rather than being stopped. A balanced approach will need to be found to keep the best of both worlds – the non-toxic world and the circular economy world. A 1000 ppm UTC threshold would fulfil these requirements.

Why a proposal for 10 ppm UTC value could be made:

Two substances of the PBDE group of flame retardants have been listed as POP substance since a number of years (Octa- and Penta-BDE). At that time the Stockholm Convention agreed that a derogation would be required for recycling. The EU therefore set a 10 ppm UTC threshold for virgin material and a 1000 ppm for recycled content. During the COP of the Stockholm Convention of 2017 some Parties of the Stockholm Convention – countries without any recycling industry for these plastics – decided for political reasons not to support a derogation for recycling for the newly defined POP of the same substance family PBDE's. Based upon this decision the proposal for a 10 ppm UTC threshold value was proposed in the EU as a logic conclusion. However the socio-economic consequences were not at all taken into account. It is easy to comply a 10 ppm threshold for virgin material – if one does not any PBDE there will be zero ppm. The recycling industry however is confronted with this legacy substance. A typical concentration of Deca-BDE if used in a television housing for instance is 150 000 ppm. No separation process works with 100 % separation efficiency. Furthermore the practical analyses methods used in the recycling industry are not fit for lower thresholds than 1000 ppm. The IEC EN 62321-3-1 Standard is not validated for any value lower than 1000 ppm Bromine. This means that compliance cannot be proven without very complex external analyses.

Conclusion and EERA comments:

The proposals for an Unintended Trace Contaminant Threshold for Deca-BDE of 10 ppm in the current POP regulation re-cast would immediately put an end to WEEE plastics recycling. With this end of the plastics recycling, the environmental benefits of recycling would cease to exist. It would also have a major socio-economic impact. Recycling is a labour intensive industry.

The recycling technology of these complex EEE products has developed over the last 15 years into becoming a mechanical recycling treatment, whereby the plastics with substances of concern such as BFRs are separated into an identifiable fraction that is monitored to prove environmentally safe treatment. These plastics are incinerated to destruct the embedded BFRs.

We therefore call for a UTC value for Deca-BDE of 1000 ppm for justify this request with the following arguments:

1. REACH did not set a threshold value for Deca-BDE of 1000 ppm until Feb. 2017 - what is the technical reason for changing this value now by a factor 100?
2. The recycling industry works with an analysis standard validated to 1000 ppm Bromine and there is no other viable test method available to date.
3. Deca-BDE is a substance from the PBDE group - 2 different limit values for substances from one group are a serious problem for the recycling industry. The other PBDE substances are listed with a threshold of 1000 ppm.
4. Separation processes always never work with a 100% precision - when we deal with parts with about 150 000 ppm Deca-BDE, one only needs very few parts that "choose" the wrong side to get a non-conforming product. We know that 1000 ppm can just about be met.
5. This new recycling industry needs a lot more capacity and we find that these legal uncertainties lead to a reduction in the willingness to invest in this industry.
6. It is easy to propose low UTC limit values for such plastics for countries without recycling industries.
7. The impact of such a low UTC threshold will be that the recycling targets for WEEE and ELV's set in the EU will not be able to be met.
8. The same counts for the EU objectives regarding circular economy and plastics strategy - how should these be achieved without further development of the plastics recycling industry for WEEE and ELV plastics?
9. Current recycling facilities will need to close their doors as a consequence.

It would be an environmental disaster if the recycling option for plastics from WEEE would cease to exist as a consequence of thresholds set too low. It would jeopardize the recycling targets set for WEEE and it would not be in line with the objectives of a circular economy and it would result in a further increase of CO_2 emissions by incineration of these plastics and by huge extra energy requirements for the production of more virgin technical plastics.