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Tenhunen, Anna

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VTT  
<http://www.vtt.fi>  
P.O. box 1000FI-02044 VTT  
Finland

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# NONTOX - Behind the scenes of WEEE, ELV and CDW waste mapping exercise to support circular economy of plastics

by Anna Tenhunen, VTT, Senior Scientist, Project Manager of NONTOX



Circular economy (CE) of plastics is complex and several solutions are needed to transition the variety of different plastics in different uses to circular. The NONTOX project develops a holistic approach to the circularity of some of the challenging plastic waste streams. The process concept aims to find an outlet for the streams that are not currently recycled to complement the current recycling schemes. An important part of this development work that supports the technical R&D activities is the analysis of the operational framework and suggestions for measures to improve it. The work behind the technical R&D activities is not always the most visible, but developing the technologies without it might result in unsustainable or unrealisable solutions. We at VTT, in collaboration with other partners Fraunhofer IVV, Relight, Stena, Galea, Coolrec, Erion, UNIVAN, Aalto and Norner, are investigating the operational framework from various points of views. Some of the most important aspects for the NONTOX project to build the framework are:

- assessment of policy framework,
- identification actions that support the transition to circular economy,
- analyses on current state of the art in recycling and the different practices across the value chains,
- techno economic assessments (TEA),
- lifecycle assessments (LCA, in NONTOX with the lead of our partner UNIVAN), and
- identification of potential raw material streams, feedstock mapping.

The NONTOX project aims to increase the recycling rates of plastic wastes originating from waste electronics and electrical equipment (WEEE), end of life vehicles (ELV) and construction and demolition waste (C&DW) that contain hazardous substances. Together, they make up approximately 36% of the European plastic demand (Plastics Europe, 2019).



Currently waste plastics containing hazardous substances, like brominated flame retardants, are discarded either by incineration or landfilling. It is important to support circular economy and mitigate the effects of incineration and landfilling, but moreover ensure safe and high-value recyclates to flow into a new life cycle preferably in same or higher value applications. Different directives and regulations regulate the use of hazardous substances and establish e.g. limit values for hazardous content in applications.

The objectives of the feedstock mapping exercise was to evaluate the volumes and current treatment routes for WEEE, ELV and CDW plastics in Europe, and to identify the plastic waste streams that are not currently recycled or are otherwise potential for our NONTOX concept. The study was carried out based on available literature, previous studies and publicly available data (e.g. Eurostat).

Regarding the current recycling systems, there are a few key points that should be highlighted in terms of recycling waste plastics from WEEE, ELV and CDW streams in Europe.

1. The current primary processes for treatment in recycling schemes are mainly developed and targeted for higher value raw material recovery like metal recovery and not plastic recovery.
2. Treatment schemes of these waste streams is extremely complex. These waste streams can contain in addition to plastics a wide range of different materials like wood, metals, glass, and so on, depending on the origin of the waste stream.
3. The range of different type of polymers used in these applications is big and more importantly, the processed waste streams are typically a mixture of these different polymers, which makes the feedstock for further upgrading very heterogeneous. Recycling very heterogeneous polymer mixtures can result in low properties, which is makes it challenging to produce high value applications.
4. The brominated flame retardants (BFR) content can vary even from 10-30% in plastic products in these streams (Andersson et al., 2019). The debromination of plastics can be hazardous and challenging, but the hazardous content cannot be put to circulation to new products in new life cycle. Due to this, BFR containing plastic waste has typically ended up to be destroyed by incineration and not recycled.

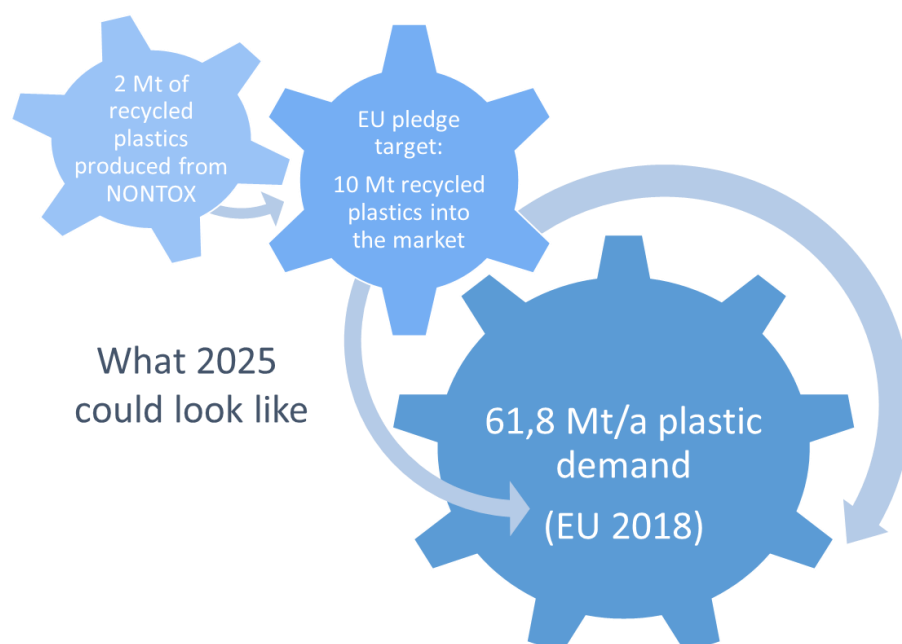
In the table below, typical shares of plastics in these waste streams' applications and typically occurring polymers are presented. Also volumes of these waste streams collected in the EU and our estimates for potential feedstock are presented. Based on our analysis on the available plastic waste streams that do not get recycled today that would be target waste streams for the NONTOX concept, we estimate that from Europe the potential waste plastic feedstock for NONTOX would be 2.18 Mt/a.

*Table 1. WEEE, CDW and ELV streams in Europe and their generalised composition and produced volumes (NONTOX D1.6 Mapping of Feedstock, 2020)*



Waste stream	Share of plastics in applications	Most typical polymers used	Volume of plastics in collected waste streams in Europe	Non-recycled plastics from collected volumes (including incinerated, landfilled, exported)
WEEE	10-51% (30% on average)	ABS, HIPS, PC, PC/ABS, PP, PPE+HIPS, PVC, PS, PA, PBT, others	0.73 Mt/a	0.82 Mt/a
CDW	4-55%	PVC, PS, PU, PE-HD, PE&PP, PS, PUR, others	1.7 Mt/a	0.51 Mt/a
ELV	13-21%	PP, PU, PA/PC, ABS, PVC, others	1.1 Mt/a	0.85 Mt/a (excluding PVC)
				TOT 2.18 Mt/a

To put that into perspective, for example as stated in the European Commission's Plastics Strategy, the Commission has launched an EU-wide pledge campaign to support that by 2025 there would be additional 10 million tonnes of recycled plastics in new product in the EU markets, which is around 16% more than today. According to the Plastics Europe, in 2019 the annual plastic demand in Europe was 62 Mt of which only about 6% is recycled plastics, which is around 3.7 Mt/a. NONTOX's potential 2.18 Mt/a of the total annual European plastic demand would be approximately 3.5% and approximately 22% of the 10 Mt/a 2025 target (compared to 2019 figure). The estimates for future European plastic demand and consumption is a slight increase.



The results of our study are that the NONTOX concept has the potential to circulate currently non-recycled plastics, increase further the recycling rates of plastics in the EU, and provide approximately additional 3.5% of recycled plastics on the markets of the total plastic demand in Europe.



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