Calculation of the carbon footprint of recycled plastics (PP, PO, HDPE and PS) from lightweight packaging at Vogt Plastic

The carbon footprint of Vogt Plastic's regranultes vary between 0.4 and 1.1 kg CO_2-eq./kg regranulate.

"Recycling of material from one product to another creates an allocation problem in life cycle assessment (LCA), because the same material is used in at least two different products. The choice of method for modeling material recycling can have a decisive impact on the environmental assessment of products". (*Ekvall et al. 2020)

Fraunhofer UMSICHT conducted a life cycle assessment (LCA) of four recycled granulates from the mechanical recycling process of Vogt Plastic. The study was carried out in accordance with international standards for LCA methodology as described in ISO 14040/44. Vogt Plastic sorts and recycles lightweight packaging waste in an integrated process that covers both waste treatment and resource provision functionality. The challenge was to identify a suitable approach to allocate the impacts between of these two functionalities, as the process differs from the conventional recycling process, using presorted bales as input.

Goal of the study: The aim was to quantify the carbon footprint of four post-post-consumer regranulates that Vogt plastic produces from lightweight household packaging waste.

Product systems studied and technical representativeness: The mechanical recycling technology studied produces high quality recycled resins from post-consumer waste from household to replace virgin material.

Intended application and audience: Besides internal learnings, the results can be disseminated to clients upon request to be used in their greenhouse gas balances.

The geographic and temporal scope: The regranulates are produced at two locations (Rheinfelden and Premnitz) in different regional collection areas. The LCA model was set up in 2022 with latest available data.

System boundary and functional unit: The system starts with the collection of post-consumer waste (burden-free) to the extrusion of the regranulates including transportation and sorting, but without customer-specific additives. The functional unit is defined as the production of 1 kg post-consumer regranulate.

Data requirements and sources: ISO 14044 and other frameworks list data quality requirements that are followed to the best of our ability. Primary data were collected for the mechanical recycling process at Vogt Plastic. Supplementary and background data are taken from the literature and modelled with the latest available data sets using the commercial LCA software "LCA for Experts".

Handling multi-functionality: A new allocation procedure for joint treatment and recycling practice was developed that best fulfills the specific LCA objective and can communicate the rationale of mechanical recycling as a multifunctional activity transparently. The entire system, from waste collection to recycled materials and recovered energy, has been modeled and economically allocated between its waste treatment and resource provision functions. The new approach is currently being further validated in a follow-up project and will be updated.

Impact assessment: The carbon footprint results show that the regranultes vary between 0.4 and 1.1 kg CO_2-eq./kg regranulate depending on the polymer type and location. The impact assessment is conducted according to IPCC AR6 (without biogenic CO_2) – from the Product Environmental Footprint Method (version 3.1).

More information on challenges and requirements in comparative LCA of plastics recycling view our position paper: https://s.fhg.de/position-paper-lca

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*Ekvall et al. (2020): Modeling recycling in life cycle assessment. Online available: https://www.lifecyclecenter.se/wp-content/uploads/2020_05_Modeling-recylingin-life-cycle-assessment-1.p