Recycling of post-consumer “Retour” PS compared to virgin PS

In the TNO study Single use Cups or Reusable (coffee) Drinking Systems:

An Environmental Comparison (2006-A-R0246(E)/B) the recycling system of PS coffee cups was studied. Disposables Benelux wants to have a comparison of the carbon footprint of recycled PS versus virgin PS. The recycling process used in the before mentioned report produces PS flakes. Disposables Benelux also wants to study a process where melt filtration is added to obtain a higher quality secondary PS.

Study setup

In this study the data of the previous Drinking Systems study were used to calculate the carbon footprint of the recycled “Retour” PS. The most recent ‘ecoinvent’ database was used for the life cycle inventories of materials, energy and processes. The carbon footprint was calculated according to IPCC GWP 100. In the current study we only included the collected and recycled PS in the system and did not include the attached waste/moisture which would add 23% to the mass to be handled.

Results

The results of the collection, pre-treatment and recycling of the used “Retour” PS cups are shown in Table 1. The carbon footprint of the system without the bonus for avoided virgin GPPS adds up to 4.56E-01 kg CO_2-eq. The main contributor to this carbon footprint is the collection of the used cups.

Table 1 Carbon footprint of 1 kg recycled PS (kg CO^2-eq.).

Total	1 Collection	2 Storage	3 Pre-treatment	4 Recycling cup flakes	5 Transport
4.56E-01	3.16E-01	9.31E-05	2.59E-03	9.06E-02	4.69E-02

The pre-treatment and recycling of the “Retour” PS cups in case PS-flakes are being produced, uses 0.457 MJ electricity per kg. A system that regranulates the PS-flakes and uses melt filtration uses 2.16 MJ electricity per kg. This results in a higher carbon footprint of the total PS recycling process. The results of this are shown in Table 2.

Table 2 Carbon footprint of 1 kg recycled PS (flakes, granulate) and virgin GPPS.

	Flakes	Granulate	Virgin GPPS
Carbon footprint (kg CO^2-eq.)	0.456	0.793	3.504
as virgin GPPS	13%	23%	100%

The carbon footprint of secondary PS flakes is only 13% of that of virgin GPPS. The carbon footprint of the higher quality secondary PS granulate is 23% of that of vigin GPPS (see Table 2). The nett carbon footprint, that includes the avoided production of virgin GPPS, of the several recycling alternatives is given in Table 3.

Table 3 Carbon footprint of 1 kg recycled PS as flakes with a 50% bonus for avoided production and granulate with either a 50% bonus or a 90% bonus.

	Flakes (50)	**Granulate (50)**	**Granulate (90)**
Carbon footprint (kg CO^2-eq.)	-1.261	-0.924	-2.297

Conclusions

The earlier conclusion of Axion recycling that secondary PS has a carbon footprint of 17% when compared to virgin PS is in line with the values that we find for recycled PS-flakes (13%) and recycled PS-granulate (23%).