Quantifying the environmental impact of different methodologies for waste collection in Biscay

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The fuel consumption is one of the most important environmental (Larsen et al, 2009) and economic (Di Maria and Micale, 2013) problem associated with the waste collection. It is know that collection systems which are closer to citizens, have the capability to collect more recyclable wastes but usually consume more resources (Iriarte et al., 2009). However, the waste collection is seldom covered in the literature and when it is, models are based on direct measurements hindering the possibility to forecast any impact. In this paper we propose a methodology able to forecast the environmental impact of new waste collection systems.

Traditionally urban waste management has been done by containerized collection of the following fractions: glass, paper and cardboard, light packaging and mixed waste. Due to legal requirements regarding organic waste management and recycling rates, new alternatives are starting to be proposed, such as 5 fraction containerized collection (5C) or door-to-door collection (D2D).

Within this work a collection model has been developed. The waste collection process is divided into 4 sub-stages: (S) Route from the truck garage to the beginning of the collection path, (DP) itinerary from the first to the last deposit point, (T) transportation to the treatment plant and finally (B) the route back to the garage. We have grouped theses stages into two phases: waste collection itself (sub-stage DP), and other activities of transport (sub-stages S, T and B).

While Table 1 present the results for a single route, Figure 1 present the results for a week. For traditional recyclable fractions about 65% of the emissions are made in transport activities. However, in the case of the mixed waste, it is split evenly between the collection and transport phases. This is explained as the mixed waste present the largest number of collection points. In absolute numbers, the glass fraction presents the highest impacts because of the distance to the treatment plant. Finally, it is important to note that, as the D2D system requires longer routes, it presents always more emissions than the 5C system.

Analysing the emissions made on one week, the glass fraction present the lowest impact while the mixed waste present the worst results. It is important to note that the impact of the mixed waste on the D2D scenario is drastically reduced as it is not recollected daily while the emission of the organic and light packaging fractions are increased. Just focusing on single routes for each fraction the D2D system presents higher impact. However, in a week management the 5C system is worst.

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Table 1: Fuel consumption and CO2-eq emission for a single route for each fraction and collection system

		Organic waste		Light packaging		Paper and cardboard		Glass		Rest	
		5C	D2D	5C	D2D	5C	D2D	5C	D2D	5C	D2D
S	Diesel (g)	3 496	2 496	3 369	2 496	3 369	2 496	3 369	3 369	3 235	2 496
	CO2 (g)	10 216	7 294	9 847	7 294	9 847	7 294	9 847	9 847	9 454	7 294
DP	Diesel (g)	4 940	16 548	7 618	16 548	8 413	16 548	7 339	7 339	11 877	16 548
	CO2 (g)	14 437	48 362	22 264	48 362	24 587	48 362	21 448	21 448	34 710	48 362
T	Diesel (g)	4 815	3 312	7 556	5 603	7 556	5 603	8 105	8 105	4 566	3 312
	CO2 (g)	14 072	9 680	22 082	16 376	22 082	16 376	23 688	23 688	13 345	9 680
B	Diesel (g)	4 630	3 455	4 338	3 256	4 338	3 256	7 202	7 202	4 630	3 455
	CO2 (g)	13 531	10 096	12 677	9 515	12 677	9 515	21 048	21 048	13 531	10 096
TOTAL	Diesel (g)	17 881	25 810	22 881	27 903	23 676	27 903	26 016	26 016	24 308	25 810
	CO2 (g)	52 256	75 431	66 869	81 546	69 192	81 546	76 031	76 031	71 041	75 431

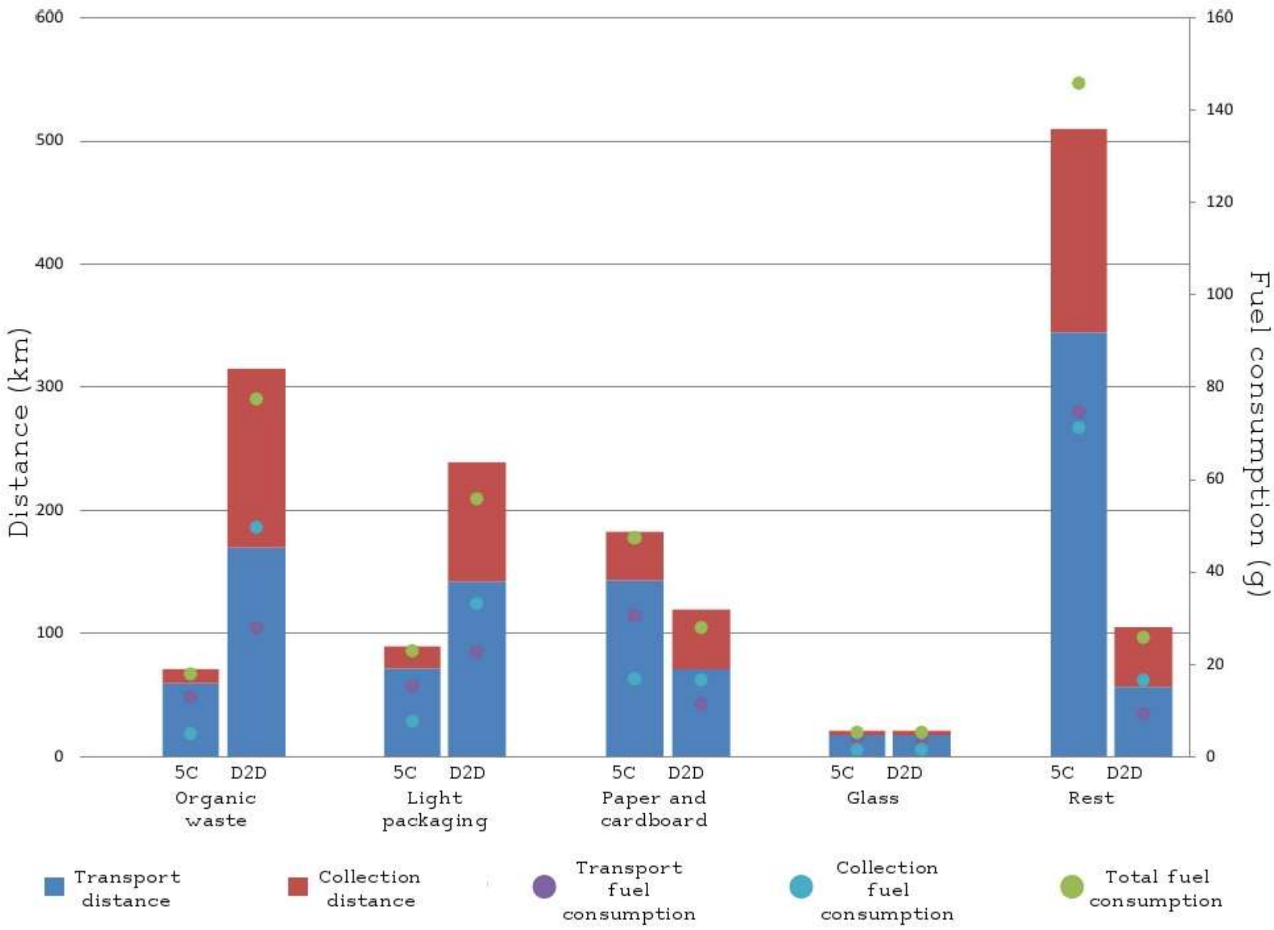

Fig. 1: Comparison of duel consumption and distance for weekly collection in 5C and D2D scenarios using the proposed methodology in Sopela (Biscay